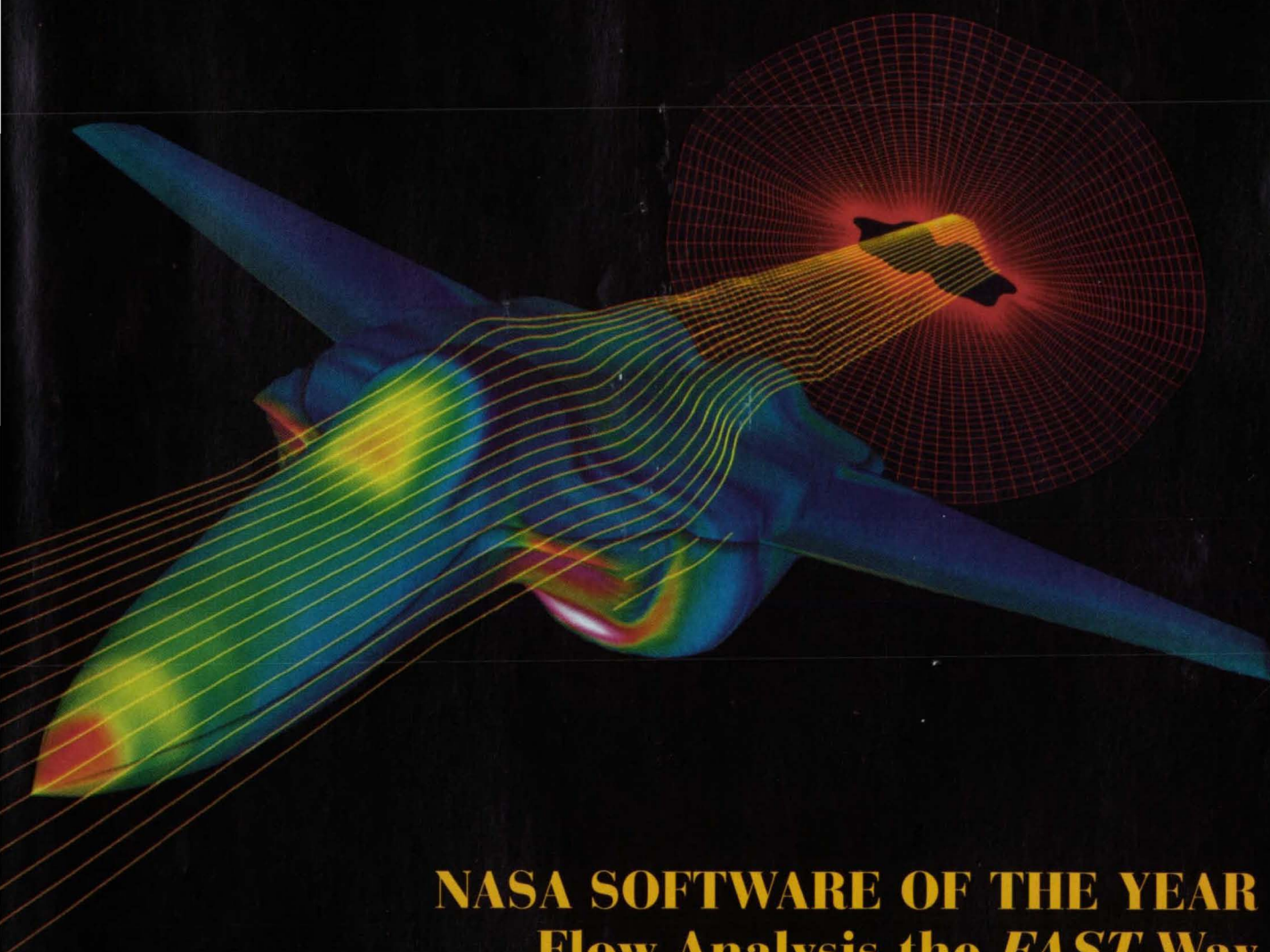


November 1995

Vol. 19 No. 11

NASA Tech Briefs

The Design/Engineering Technology Digest

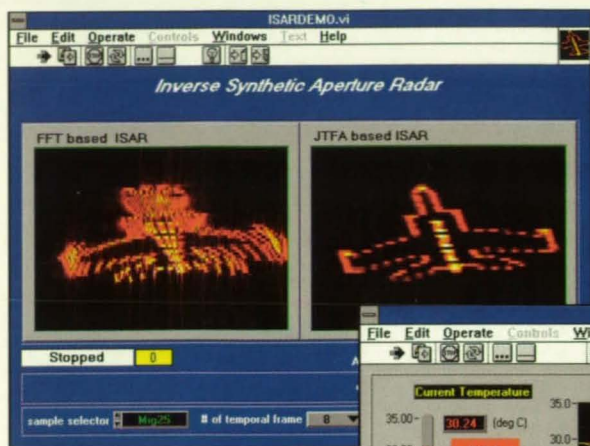


NASA SOFTWARE OF THE YEAR
Flow Analysis the *FAST* Way

Microelectronics Focus

New NDE Tools

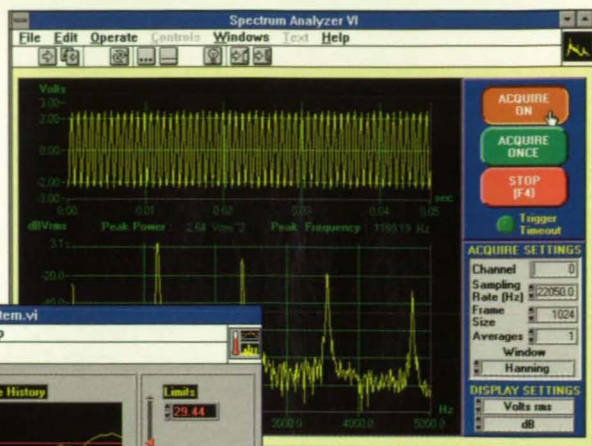
Resource Report:
Marshall Space Flight Center



Test and Measurement

"Programming in LabVIEW reduced the development time of our system from the expected 16 months to four months and allowed us to quickly make changes to our system."

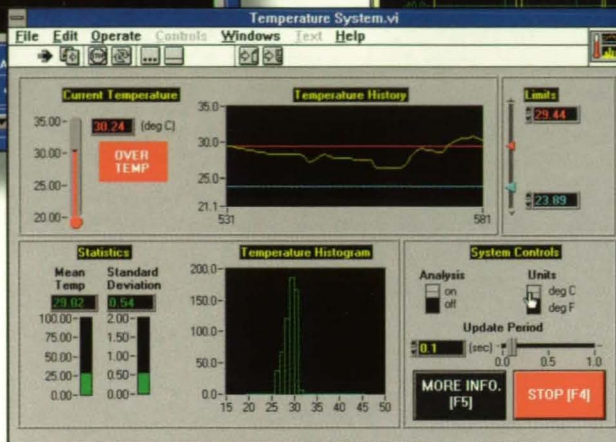
Keith Simmons
Electrical Engineer



Virtual Instrumentation

"LabVIEW handles the 'nuts and bolts' of computer programming without my knowledge of the details. That makes it what I call an engineer's and scientist's programming language."

John O'Neal
Laboratory Automation Specialist



Process Monitoring and Control

LabVIEW®

Proven Productivity for Your Industry

To increase productivity and reduce time to market, you need software that's easy to use, yet versatile enough to handle your demanding applications. Whether you're in research, production, automation, or test, the key to success is software – software that empowers your organization to build higher quality products faster and for less money. That's where LabVIEW comes in.

Software Innovation – for Your Applications

LabVIEW, the leading graphical programming language, gives you the software to automate your measurement, control, and analysis applications. LabVIEW pioneered Virtual Instrumentation almost a decade ago and continues to deliver proven productivity through breakthrough innovations and years of customer feedback.

Flexible I/O – for Your Instrumentation

LabVIEW communicates with thousands of I/O devices, including our complete line of data acquisition hardware, GPIB and

VXI instruments, serial devices, PLCs, and much more. Take advantage of the hundreds of instrument drivers and ready-to-run programs included with LabVIEW.

Solutions Worldwide – for Your Industry

Today, LabVIEW is making a difference in many industries, including automotive, telecommunications, semiconductor, electronics, aerospace, chemical, and education. Industry leaders worldwide use LabVIEW because it delivers proven productivity over and over again. For specialized needs, hundreds of third-party Alliance Program companies are ready with their LabVIEW expertise.

If you want to learn more about LabVIEW, give us a call. We'll show you how you can benefit from the graphical programming power of LabVIEW – **It's Proven Productivity for Your Industry.**



Call (800) 433-3488
today for **FREE** LabVIEW
demo software.



U.S. Corporate Headquarters: Tel: (512) 794-0100 • Fax: (512) 794-8411 • E-mail: info@natinst.com • WWW: <http://www.natinst.com>

Branch Offices: Australia 03 9 879 9422 • Austria 0662 45 79 90 0 • Belgium 02 757 00 20 • Canada 519 622 9310 • Denmark 45 76 26 00
Finland 90 527 2321 • France 1 48 14 24 24 • Germany 089 741 31 30 • Hong Kong 2645 3186 • Italy 02 48301892 • Japan 03 5472 2970
Korea 02 596 7456 • Mexico 95 800 010 0793 • Netherlands 03480 33466 • Norway 32 84 84 00 • Singapore 2265886 • Spain 91 640 0085
Sweden 08 730 49 70 • Switzerland 056 20 51 51 • Taiwan 02 377 1200 • U.K. 01635 523545

© Copyright 1995 National Instruments Corporation. All rights reserved. Product and company names listed are trademarks or trade names of their respective companies.

Ask about our Windows® 95 32-bit software

For More Information Write In No. 503



**Look to
OMEGA for
All Your Data
Acquisition
requirements.**

Model
OM-NOMAD-T-8
\$135
Basic Unit

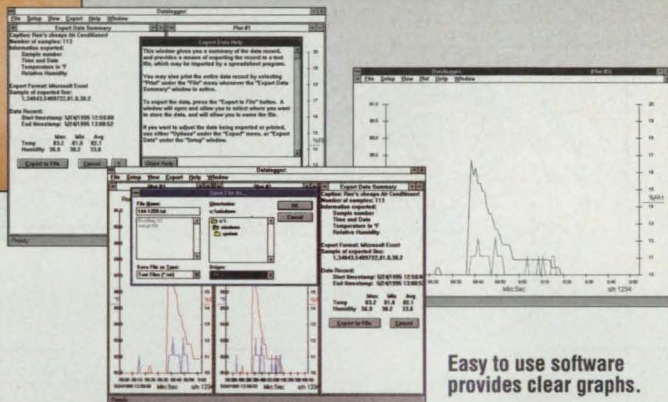


615
Circle Reader
Service Number
or Dial OMEGafaxSM
Service and Enter
Document #6358

The NOMADTM
datalogger is
available with
Windows or
MAC software.



- ☒ Compact Size
- ☒ Programmable Limit Alarms with LED Indicator
- ☒ Two Year Battery Life
- ☒ Stores Samples in Non-Volatile Memory
- ☒ Software Available for DOS, Windows or Macintosh



Easy to use software
provides clear graphs.

Portable, Low Cost NOMADTM Datalogger

Temperature and Temperature/Humidity Dataloggers

Quality, Outstanding Service, Dependability – these are the measures of a leader. Since 1962 OMEGA Engineering has been the leader you can count on to deliver reliable products, superior sales and unsurpassed technical support. OMEGA Engineering – over 41,000 precision, quality-crafted instruments and counting.

PRODUCTS

41,500+
AVAILABLE

**See OMEGA on
The WORLD WIDE WEB!!**

OMEGAnetSM
ON-LINE SERVICE

<http://www.industry.net/omega>
<http://www.industry.net/omega>



OMEGafaxSM

OMEGA's 24-Hour-a-Day,
On-Demand Publishing Service
Dial 1-800-848-4271

from any Touch-Tone phone, and just enter the OMEGafax numbers for the products you're interested in. A product specification sheet will be faxed to you automatically. Don't forget to have your fax number handy!

REQUEST YOUR FREE COPY!

- ☒ Over 500 Full-Color Pages!
- ☒ Hundreds of Pages of Valuable Technical Reference Material
- ☒ Full Specifications and Pricing Always Listed

Circle No. 616 for Handbook or
request Document #9988 from the
OMEGafaxSM Service



OMEGA Engineering, Inc.
One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047
Tel: (203) 359-1660 Fax: (203) 359-7700
© COPYRIGHT 1995 OMEGA ENGINEERING, INC.
ALL RIGHTS RESERVED.

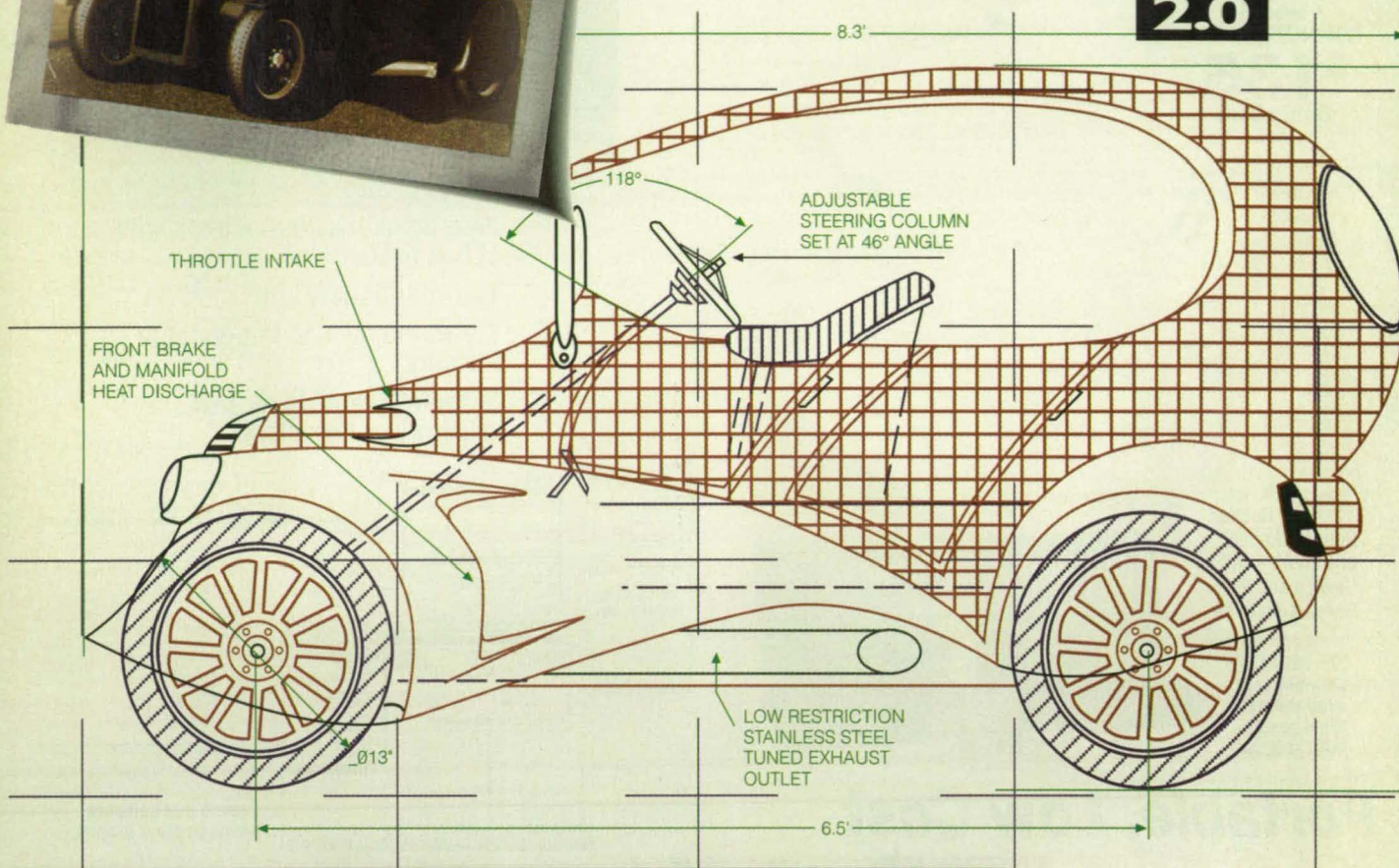
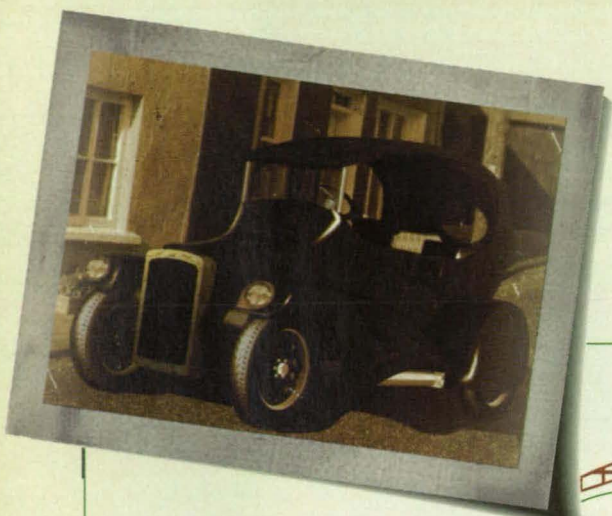
OMEGA[®]

Reliability You Can Count On.

For Sales and Service Call:

1-800-82-66342SM
1-800-TC-OMEGA

NEW
VISUAL
CADD
2.0



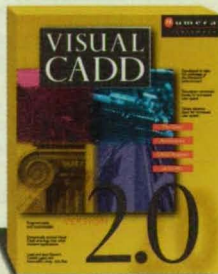
**If Henry Ford Had Used
The Power Of Visual CADD,[™]
Things Might Look Different.**

SUPER PRODUCTIVE DRAFTING FOR WINDOWS® 95

NUMERA VISUAL CADD 2.0 ESTABLISHES A NEW LEVEL OF CAD PERFORMANCE FOR UNDER \$600. THIS POWERFUL CAD PROGRAM DELIVERS PROFESSIONAL DRAFTING FEATURES, OPEN ARCHITECTURE AND FULL COMPATIBILITY WITH OTHER CAD PACKAGES. IT'S NATIVE FOR 32-BIT WINDOWS® 95 AND COMES LOADED WITH NEW FEATURES LIKE MULTIPLE VIEWS, DIRECT PLOT AND WIZARDS. ENJOY ADVANCED, YET SIMPLE EDITING TECHNIQUES THAT LET YOU ADD, SUBTRACT AND INTERSECT TWO OR MORE CROSSING SHAPES. PLUS, IT NOW OFFSETS MULTIPLE ENTITIES.

VISUAL CADD IS MICROSOFT® OFFICE COMPATIBLE AND DELIVERS SEAMLESS INTEGRATION WITH CUSTOMIZED COMMANDS ON MENUS, TOOL PALETTES AND KEYBOARD SHORTCUTS. GET FULL READ-WRITE CAPABILITIES FOR AUTOCAD®, DWG, DXF FILES AND GENERIC CADD® .GCD FILES. THIS IS THE FIRST

OF A NEW GENERATION OF WINDOWS 95 CAD. AS HENRY MIGHT SAY, "THERE'S A VISUAL CADD IN YOUR FUTURE" AND IT'S ONLY \$595!



VISUAL
CADD

FOR MORE INFORMATION AND A FREE DEMO, CALL:
1-800-956-2233 EXT. 102
VISIT THE NUMERA HOME PAGE: <http://www.numera.com>
e-mail: info@numera.com

For More Information Write In No. 660

numera
Software

Make quick cash from surplus test equipment.



Calibrated & NIST Traceable Used Equipment,
Factory Authorized New Equipment

FREE TEST EQUIPMENT CATALOG

RF & microwave equipment,
spectrum analyzers,
synthesizers, oscilloscopes,
environmental chambers,
power supplies and more!

RAG Buys Test Equipment

To sell test equipment
you're no longer using,
call RAG
and ask for purchasing.

RAG Electronics, Inc.

1-800-590-3457

To order a FREE catalog call...

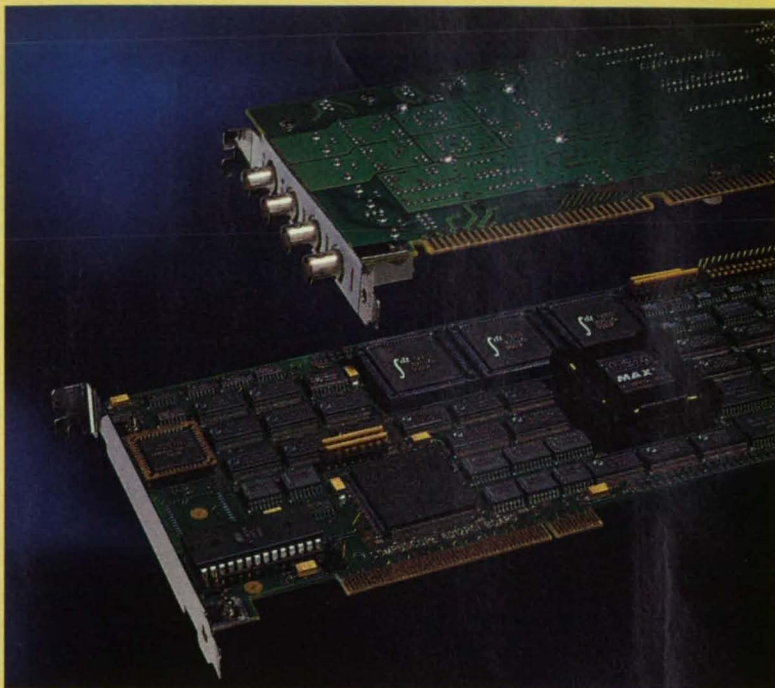
2450 Turquoise Circle, Newbury Park, California, U.S.A. 91320-1200 • FAX 805-498-3733 • Tel: 805-498-9933

For More Information Write In No. 508

World's Fastest A/D Cards For ISA & PCI Bus

Now Available on the
PCI Bus !!

- ◆ 12 Bit, 60 MSPS Sampling
- ◆ 90 MB/s Transfer Rate



ISA Bus

- ✓ 250 MSPS, 8 Bit A/D Card
- ✓ 60 MSPS, 12 Bit A/D Card
- ✓ 20 MSPS, 12 Bit D/A Card
- ✓ 16 Meg Memory
- ✓ Up to 32 inputs in one chassis
- ✓ Drivers in C, BASIC, Windows DLL
- ✓ FREE GageScope software

CS6012/PCI	PCI BUS	12 bit / 60 MSPS / 512K	\$8,995
CS6012	ISA BUS	12 bit / 60 MSPS / 512K	\$6,995
CS1012	ISA BUS	12 bit / 20 MSPS / 512K	\$4,995
CS2125	ISA BUS	8 bit / 250 MSPS / 256K	\$4,995
CS250	ISA BUS	8 bit / 100 MSPS / 32K	\$3,500
CS225	ISA BUS	8 bit / 50 MSPS / 128K	\$1,995
CSLITE	ISA BUS	8 bit / 40 MSPS / 16K	\$595

U.S. Prices listed above. International prices may vary

CALL 1-800-567-GAGE

Ask for extension 3406

4 2 4 3

GAGE

GAGE APPLIED SCIENCES INC.

5610 Bois Franc Street

MONTREAL QC, CANADA H4S 1A9

Tel : (514) 337-6893. Fax : (514) 337-8411

BBS : (514) 337-4317. CompuServe : 73042,346

e-mail: prodinfo@gage-applied.com

ftp site: [ftp.gage-applied.com](ftp://ftp.gage-applied.com/) (/clients/gage-applied/public/)

When Every Second Counts!



Call, write, fax or
visit us on the Internet
for your
FREE CATALOG today!

Digi-Key
CORPORATION

Quality Electronic Components, Superior Service

1-800-344-4539

701 Brooks Ave. South,
Thief River Falls, MN 56701
Fax: 218-681-3380

<http://www.digikey.com>

**Your Ultimate Source For
Quality Electronic Components!**
#1 for Availability of Product
#1 for On-Time Delivery
#1 for Overall Performance



On orders placed by
5:00 pm central time.

Contents

NASA Tech Briefs

Official Publication of the National
Aeronautics and Space Administration

FEATURES

- 18 Mission Accomplished
- 20 Resource Report:
Marshall Space Flight Center
- 58 NASA 1995 Software of
the Year Award

TECHNICAL SECTION

22 Special Focus: Microelectronics



- 22 Microbolometers Based on Epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Thin Films
- 26 Garnet Random-Access Memory
- 28 Fabrication of SNS Weak Links on SOS Substrates
- 30 High-Voltage MOSFET Switching Circuit
- 30 Asymmetric Switching for a PWM H-Bridge Power Circuit
- 32 Better Ohmic Contacts for InP Semiconductor Devices

36 Electronic Components and Circuits



- 36 Low-Bandgap Thermovoltaic Materials and Devices
- 38 Digital Frequency-Differencing Circuit
- 40 Imaging Magnetometer

42 Electronic Systems



- 42 Computer-Assisted Monitoring of a Complex System
- 42 Buffered Telemetry Demodulator
- 46 Compact Multifunction Inspection Head

48 Physical Sciences



- 48 Optical Detection of Fractures in Ceramic Diaphragms
- 48 Eddy-Current Detection of Cracks in Reinforced Carbon/Carbon
- 50 Apparent Thermal Conductivity of Multilayer Insulation

51 Materials



- 51 Optimizing Misch-Metal Compositions in Metal Hydride Anodes
- 52 Device for Sampling Surface Contamination

54 Computer Programs



- 54 Probabilistic Failure Assessment for Fatigue
- 54 Probabilistic Fatigue and Flaw-Propagation Analysis

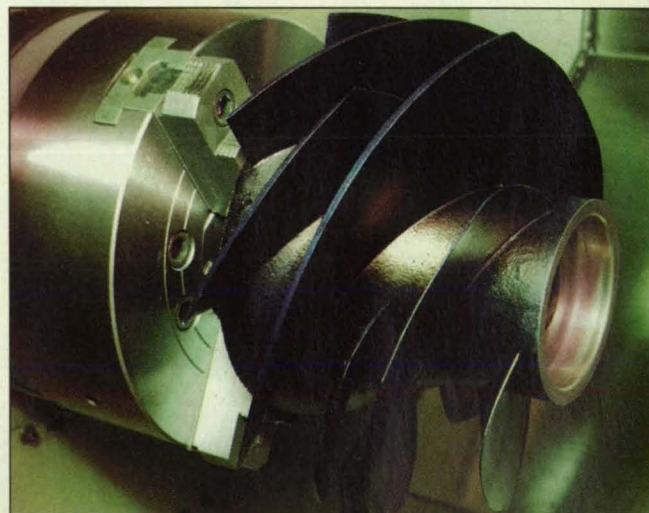
- 57 Windows Program for Driving the TDU-850 Printer
- 58 Subband/Transform MATLAB Functions for Processing Images
- 59 Computing Equilibrium Chemical Compositions
- 60 Program Processes Thermocouple Readings
- 60 ICAN—Second-Generation Integrated Composite Analyzer
- 62 Integrated Composite Analyzer with Damping Capabilities
- 62 Computing Efficiency of Transfer of Microwave Power
- 63 Program Calculates Power Demands of Electronic Designs
- 63 Cost-Estimation Program
- 64 Program Estimates Areas Required by Electronic Designs
- 64 Program to Balance Mapped Turbopump Assemblies
- 66 BiblioTech

70 Mechanics



- 70 Controlling Mirror Tilt With a Bimorph Actuator
- 71 Burst-Disk Device Simulates Effect of Pyrotechnic Device

(continued on page 8)



Marshall Space Flight Center assisted North American Marine Jet Inc. of Benton, AR, in improving the design of a new impeller for its marine jet propulsion systems. Marshall engineers created a 3D computer model of the design, and used the Materials and Processes Laboratory's Rapid Prototyping Center to produce a solid honeycomb model of the new impeller design. For more information on Marshall facilities, see the Resource Report on page 20.

(Photo courtesy of Marshall Space Flight Center)

The Only 35 GB Tape Drive With Fast SCSI Compression



All tape subsystems are not created equal. Only the CY-8505 can give you capacity of up to 35 GB and transfer rates as fast as 90 MB per minute.

That's because the CY-8505 is the only tape subsystem that features switch-selectable, Fast SCSI Compression. So you get the highest performance possible — and the lowest cost per megabyte.

A MTBF of 160,000 hours ensures reliability. The bit error rate of less than 1 in 10^{17} is the best in the industry. A backlit display gives you complete status information, including command under execution, transfer rate, compression ratio, tape remaining, and more.

The CY-8505 is the most advanced tape subsystem on the market, and it offers the most innovative options.

True Compatibility With:

Alliant	DEC TUI/A81	NCR	Silicon Graphics
Alpha Micro	DEC Unibus	NeXT	STC
Altos	Gould/Encore	Novell	Stratus
Apollo	HP	OS/2	Sun
Arix	IBM AS/400	PS/2	Texas
AT&T	IBM Mainframe	Parallel Port	Instruments
Basic-4	IBM RISC/6000	PC 386/ix	Unisys
Concurrent	IBM RT	PC MS-DOS	Ultimate
Convergent	IBM S/38	PC Xenix/Unix	Wang
Data General	ICL	Pertec	Windows NT
DEC SCSI	Intergraph	PICK	— and more
DEC BI-Bus	Macintosh	Plexus	
DEC DSSI	McDonnell	Prime	
DEC HSC	Douglas	Pyramid	
DEC Q-Bus	Motorola	Sequent	

Fast SCSI Compression can increase the native 7 GB capacity by as much as five times; *Accelerated File Access* (for Unix systems) allows you to locate a file in an average of 85 seconds; *Data Encryption* lets you control access to sensitive data through the use of

uniquely encoded card keys; and the *Advanced SCSI Processor* allows multiple drives to work together in striping, mirroring, cascade and independent modes. You can even copy and verify tapes off-line.

Compatible with virtually every computer system and network, the CY-8505 is available in a single or dual desktop unit, in a rack mount configuration, or as part of a tape library system that can store as much as 3 TB.

Backed by a two year warranty and our responsive in-house technical support group, the CY-8505 is fast setting the pace in data storage.

For more information, call today at
(804) 833-9000.



Our CY-CHS10A features two tape drives and can store up to 385 GB on eleven tapes — without tape handling.

CYBERNETICS

Tera One • Yorktown, Virginia 23693 • Fax (804) 833-9300

For More Information Write In No. 529

Contents *(continued)*

- 72 Bearing-Mounting Concept Accommodates Thermal Expansion
- 74 Parallel-Plate Acoustic Absorbers for Hot Environments
- 78 Adjustable-Length Strut Withstands Large Cyclic Loads
- 79 Tool Indicates Contact Angles in Bearing Raceways
- 79 Gravity Slides With Magnetic Braking
- 80 High-Torque, Lightweight, Pneumatically Driven Wrench for Small Spaces
- 80 Device for Testing Compatibility of an O-Ring

81 Machinery



- 81 Magnetic Heat Pump Containing Flow Diverters
- 82 Variable-Tilt Helicopter Rotor Mast
- 83 "Beach-Ball" Robotic Rovers
- 84 Apparatus Would Measure Temperatures of Ball Bearings

86 Manufacturing/Fabrication



- 86 Flexible Borescope for Inspecting Ducts
- 86 Texturing Copper To Reduce Secondary Emission of Electrons
- 87 Automated Laser Cutting in Three Dimensions

89 Mathematics and Information Sciences



- 89 Algorithm Helps Monitor Engine Operation
- 90 Flexible Revision of Data-Processing Communications
- 91 Software for Managing the Use of Land

92 Books and Reports



- 92 Thermal Strap Increases Cryocooling Efficiency
- 92 Reversible Nut With Engagement Indication
- 92 Control Algorithms for Kinematically Redundant Manipulators
- 92 Computed Hydrogen-Flow Splits in a Rocket Engine
- 92 Pressure and Thermal Modeling of Rocket Launches
- 92 Field of View of a Spacecraft Antenna: Analysis and Software
- 93 Digital Controller for Laser-Beam-Steering Subsystem
- 93 More About Beam-Steering Subsystem for Laser Communication

DEPARTMENTS

NASA Commercial Technology Team	14
New Product Ideas	16
New on the Market	100
New on Disk	102
New Literature	103
Advertisers Index	105

- 93 Digital Controller for Laser-Beam-Steering Subsystem: Part 2
- 94 Interface Circuit Board for Space-Shuttle Communications
- 94 Automated Planning of Spacecraft Telecommunications
- 94 Artifacts of Spectral Analysis of Instrument Readings
- 94 Neural-Network Controller for Vibration Suppression
- 94 Adaptive Finite-Element Computation in Fracture Mechanics
- 94 Attitude Control for the Cassini Spacecraft
- 95 Analytical Model for Fluid Dynamics in a Microgravity Environment
- 95 Study of Rocket-Engine Joints Bonded by Ni/Cu/NARloy-Z
- 96 Improved Silicon Nitride for Advanced Heat Engines
- 96 Parameters for Welding Aluminum/Lithium Alloys
- 96 Lightweight Composite Intertank Structure
- 96 Foil Patches Seal Small Vacuum Leaks
- 99 Data Base on Cables and Connectors
- 99 Effect of Clock Mode on Radiation Hardness of an ADC
- 99 Fault-Tolerant Control for a Robotic Inspection System

1A-21A Federal Laboratory Test & Measurement Tech Briefs

Follows page 80 in selected editions only.

On the Cover:

The Flow Analysis Software Toolkit (FAST) from Ames Research Center was named NASA's 1995 Software of the Year. FAST, initially developed for CFD analysis, turns any type of 3D data into 3D animation. FAST visualization created for use with HDTV shows the F-15 aircraft with traces, scalar mapping, and grid. For more on FAST, and the award finalists, see page 58.

(Visualization by John West, Sterling Software; grid and solution courtesy of Drs. David Huddleston and Bharat Soni, NSF Engineering Research Center for Computational Field Simulation, Mississippi State University.)

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither Associated Business Publications Co., Ltd. nor the United States Government nor any person acting on behalf of the United States Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights. The U.S. Government does not endorse any commercial product, process, or activity identified in this publication.

Permissions: Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Associated Business Publications, provided that the flat fee of \$3.00 per copy be paid directly to the Copyright Clearance Center (21 Congress St., Salem, MA 01970). For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Service is: ISSN 0145-319X/94 \$3.00+.00

NASA Tech Briefs, ISSN 0145-319X, USPS 750-070, copyright © 1995 in U.S. is published monthly by Associated Business Publications Co., Ltd., 317 Madison Ave., New York, NY 10017-5391. The copyright information does not include the (U.S. rights to) individual tech briefs that are supplied by NASA. Editorial, sales, production, and circulation offices at 317 Madison Ave., New York, NY 10017-5391. Subscription for non-qualified subscribers in the U.S., Panama Canal Zone, and Puerto Rico, \$75.00 for 1 year; \$125 for 2 years; \$200.00 for 3 years. Single copies \$10.00. Foreign subscriptions one-year U.S. Funds \$150.00. Remit by check, draft, postal, express orders or VISA, MasterCard, and American Express. Other remittances at sender's risk. Address all communications for subscriptions or circulation to NASA Tech Briefs, 317 Madison Ave., New York, NY 10017-5391. Second-class postage paid at New York, NY and additional mailing offices.

POSTMASTER: Please send address changes to NASA Tech Briefs, P.O. Box 10523, Riverton, NJ 08076-0523

For Information on Finite Element Design and Analysis



Stop by Our Place

WWW.ALGOR.COM

When you visit Algor's Internet Home you can...

- **Learn** more about FEA, whether you're a novice, or a "guru"
- **Download** free software - real software, not just demos
- **Find** the information you need fast with Algor's exclusive Magellan Search Commander
- **Discover** unique books, videos and interactive, multimedia CD-ROM products that will help you better understand and use any FEA software
- **Compare** notes with some of the world's most accomplished engineers through Algor's application illustrations
- **Try** your hand at a variety of verification problems
- **Get** the latest update and new product information for Algor customers
- **Communicate** directly with Algor sales, engineering and development people, or even the President
- **Do** something new every time you return



E-mail: info@algor.com

Algor...Number One in Internet Communications for FEA

For More Information Write In No. 525

Vespel[®] parts can handle some of the toughest jobs.

Like paying for themselves.

Everyone knows that Vespel[®] polyimide parts improve performance in severe service applications by withstanding extreme heat, friction, pressure and contamination—with minimal or no lubrication. But now manufacturers who use Vespel parts in general applications are beginning to notice improvements

somewhere else: *the bottom line*. That's because the reliability and long life of Vespel parts can make them the most cost-effective choice for general applications in the long term.

If your applications require parts that can withstand extreme temperatures (-350°F to 550°F), Vespel should be your first choice. Vespel should



Insulators. In plasma-arc cutting torches, Vespel insulators provide superior strength and durability at high temperatures up to 550°F, lasting up to six times longer than fragile ceramic insulators.



Seal Rings. In the assembly of automobile transmissions, Vespel seal rings reduce costs by replacing expensive metal rings, which can fracture or deform during assembly. They also reduce warranty costs by producing a better seal.



Thrust Washers. In farm tractor transmissions, Vespel thrust washers reduce costs and manufacturing time by eliminating the need for secondary machining. Vespel washers also exhibit high performance and low wear with limited or no lubrication.



Bearings. In photocopiers, Vespel composite idler gear hub bushings are a cost-effective alternative to metal. The Vespel parts provide ultra-high temperature resistance and dimensional stability while offering a low coefficient of friction, as well as long life without lubrication.



Bushings. In aircraft engine vanes, Vespel bushings withstand high-frequency vibration dithering and offer excellent stability and lubricity at high temperatures. They also reduce assembly time.



Wear Strips. In textile equipment, Vespel tenter frame clip wear strips reduce costs by eliminating the need for lubrication. They also improve textile manufacturing quality by eliminating oil contamination, and provide good wear and temperature resistance.

also be considered if you have parts that rub together, if metal parts are too noisy, or if fluid flow needs to be controlled.

Superior strength and reliability aren't the only ways Vespel can save you money. Often, you can consolidate two or more existing parts in one Vespel piece.

IF YOU WANT TO GET TECHNICAL

For information, call 1-800-426-7246.
Or write: DuPont Vespel®
Product Information Center, P.O. Box 1138,
Bloomfield Hills, MI 48303-1138.

And Vespel parts can be direct-formed, which eliminates machining costs.

When you consider how cost-effective Vespel parts can be in the long term, it's clear that we don't just make better bushings, bearings, washers and seals. *We make better sense.*



Vespel®
Only by DuPont

REAL-TIME VIDEO ON COMPUTERS

SIMULATION C³I SURVEILLANCE
INTERACTIVE VIDEO DISC TRAINING
ROBOTICS INDUSTRIAL CONTROL
VIDEO TELECONFERENCING



SUPERVIEW™ OFFERS

Up to 6 real time video windows

Windows scaleable to full screen

Optional inputs for FLIR, radar,
VGA and medical imagers

Text and graphics overlays on
video

Compatibility with all high
resolution graphics controllers

*Video windowing systems are available in
standalone and board level configurations*



SPECTRUM®

A visual communications company™

950 Marina Village Parkway Alameda, CA 94501
Tel: (510) 814-7000 Fax: (510) 814-7026

NASA Tech Briefs

Published by Associated Business Publications
President/Chief Executive Officer Bill Schnirring
Publisher Joseph T. Pramberger
Senior Editor Linda L. Bell
Editor, Federal Lab Tech Briefs Robert Clark
Production Manager Donna Pituras
Advertising Coordinator Margery Koen
Art Director Lois Erlacher
Production Artist Brian Edgar
Circulation Director Martin J. Horan
Assistant Circulation Director Lori Coppin
Telemarketing Specialist Evelyn Mars
Assistant to Reader Service Manager Damiana Garcia

BRIEFS & SUPPORTING LITERATURE: Written and produced for NASA by
Advanced Testing Technologies, Inc., Commack, NY 11725

Technical/Managing Editor Ted Selinsky
Sr. Technical Analyst Dr. Larry Grunberger
Art Manager Eric Starstrom
Administrator/Chief Copy Editor Greg Galitzine
Staff Writers/Editors Dr. Theron Cole, George Watson,
Howard Falk, Gail Pyke
Graphics Robert Simons
Editorial & Production Joan Schmiemann, Caroline Weaver
Becky D. Bentley

NASA:

NASA Tech Briefs are provided by the National Aeronautics and Space
Administration, Technology Transfer Division, Washington, DC:

Administrator Daniel S. Goldin
Director, Commercial Technology Robert Norwood
Manager, Technology Transfer Office, NASA Center
For AeroSpace Information Walter M. Heiland

ASSOCIATED BUSINESS PUBLICATIONS

317 Madison Avenue, Suite 921, New York, NY 10017-5391
(212) 490-3999 FAX (212) 986-7864

President/Chief Executive Officer Bill Schnirring
Executive Vice President/Chief Operating Officer Domenic A. Mucchetti
Treasurer Joseph T. Pramberger
Credit/Collection Felecia Lahey
Staff Accountant Larry Duze
Trade Show Director Wendy S. Janiel
Trade Show Manager Tricia Palumbo
Exhibition Sales Wayne Pierce
Trade Show Coordinator Tracy A. Wenz
Human Resources Manager Lourdes Del Valle
MIS Manager Ted Morawski
Assistant MIS Manager Pak Tong
MIS Data Entry Roxanne Portella
Office Manager Sylvia Valentin
Mailroom Operations Thomas C. Snyder, Rose D'Addazio
Administrative Assistant Christine Saluzzi

NASA TECH BRIEFS ACCOUNT EXECUTIVES

NY, NJ (Area Code 201) Doug Shaller
at (212) 490-3999
PA, DE, NJ (Area Code 908, 609), VA, DC, MD, WV Tara Morie
at (610) 640-3118
Eastern MA, NH, ME, RI Paul Gillespie at (508) 429-8907
Bill Doucette at (508) 429-9861
Western MA, CT, VT George Watts
at (802) 875-3310
Southeast, South Central Robert Hubbard
at (910) 299-7754
OH, MI, IN, KY Louise Clemens
at (216) 479-6868
IL, WI, MO, IA, MN, ND, SD, NE, KS Melinda Mead
at (312) 296-2040
N. Calif., CO Bill Hague
at (415) 974-1211
WA, OR, ID, MT, WY Bill Madden; Bill Hague
at (206) 858-7575
S. Calif., (Area Codes 909, 818, 805, 213, 310), NV, UT Tom Stillman
at (310) 372-2744
S. Calif., (Area Codes 619, 714), AZ, NM Richard Ayer; Jane Hayward
at (714) 366-9089
Japan Akio Saljo
at 03 (5691) 3335

How To Reach Us On Line

Letters to the editor: ntb_edit@interramp.com

To find out about advertising opportunities:
ntb_advertise@interramp.com

For information on the Technology 2005 conference
(October 24-26, Chicago): <http://www.keds.com/tech2005>
NASA Tech Briefs home page: <http://www.keds.com/ntb>

COLE-PARMER® 1995-1996

CALL TOLL-FREE (800) 323-4340

Serving the Research & Technical Communities Worldwide



COLE-PARMER® serving the RESEARCH & TECHNICAL COMMUNITIES WORLDWIDE

COLE-PARMER® gives you quality service. Our Sales associates, Application Specialists, and Customer Satisfaction representatives are always ready to give you prompt assistance.

The COLE-PARMER® catalog gives you a wide selection of more than 40,000 products for Research, Industry, and Education and it's . . .

FREE!

The COLE-PARMER® catalog also gives you information that you can use everyday.

This 1760-page resource includes technical information, conversion tables, and chemical resistance charts.

To receive your FREE 1995-1996 COLE-PARMER® catalog, fax back the coupon at left or call our literature hotline.

(800) 443-3434



**Cole Parmer®
Instrument Company**

625 E. Bunker Court Vernon Hills, IL 60061

Send us the "FAX" to get your FREE Cole-Parmer Catalog!

FAX: (708) 549-7676

Name: _____

Title/Mail Stop: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____

NASA 11/95

For More Information Write in No. 528

NASA Commercial Technology Team

NASA's R&D efforts produce a robust supply of promising technologies with applications in many industries. A key mechanism in identifying commercial applications for this technology is NASA's national network of commercial technology organizations. The network includes ten NASA field centers, six Regional Technology Transfer Centers (RTTCs), the National Technology Transfer Center (NTTC), business support organizations, and a full tie-in with the Federal Laboratory Consortium (FLC). We encourage all businesses with technical needs to contact the appropriate organizations for more information. For those who have access to the Internet, general information can be accessed with Mosaic software on the NASA Commercial Technology Home Page at URL: <http://nctn.oact.hq.nasa.gov>. Instructions regarding how to acquire the free Mosaic software can be obtained by sending an e-mail request to: innovation@oact.hq.nasa.gov.

NASA's Technology Sources

If you need further information about new technologies presented in NASA Tech Briefs, request the Technical Support Package (TSP) indicated at the end of the brief. If a TSP is not available, the Commercial Technology Office at the NASA field center that sponsored the research can provide you with additional information and, if applicable, refer you to the innovator(s). These centers are the source of all NASA-developed technology.

Ames Research Center

Selected technological strengths: Fluid Dynamics; Life Sciences; Earth and Atmospheric Sciences; Information, Communications, and Intelligent Systems; Human Factors. Syed Shariq (415) 604-0753 syed_shariq@qmgate.arc.nasa.gov

Dryden Flight Research Center

Selected technological strengths: Aerodynamics; Aeronautics; Flight Testing; Aeropropulsion; Flight Systems; Thermal Testing; Integrated Systems Test and Validation. Lee Duke (805) 258-3119 duke@louie.drrf.nasa.gov

Goddard Space Flight Center

Selected technological strengths: Earth and Planetary Science; Missions; LIDAR; Cryogenic Systems; Tracking; Telemetry; Command. George Alcorn (301) 286-5810 galcorn@gsfc-mail.nasa.gov

Jet Propulsion Laboratory

Selected technological strengths: Near/Deep-Space Mission Engineering; Microspacecraft; Space Communications; Information Systems; Remote Sensing; Robotics. Wayne Schober (818) 354-2240 wayne.r.schober@jpl.nasa.gov

Johnson Space Center

Selected technological strengths: Artificial Intelligence and Human Computer Interface; Life Sciences; Human Space Flight Operations; Avionics; Sensors; Communications. Hank Davis (713) 483-0474 hdavis@jp101.jsc.nasa.gov

Kennedy Space Center

Selected technological strengths: Emissions and Contamination Monitoring; Sensors; Corrosion Protection; Bio-Sciences. Bill Sheehan (407) 867-2544 billsheehan@ksc.nasa.gov

Langley Research Center

Selected technological strengths: Aerodynamics; Flight Systems; Materials; Structures; Sensors; Measurements; Sciences. Charlie Blankenship (804) 864-6005 c.p.blankenship@larc.nasa.gov

Lewis Research Center

Selected technological strengths: Aeropropulsion; Communications; Energy Technology; High Temperature Materials Research. Walter Kim (216) 433-3742 wskim@lms01.lerc.nasa.gov

Marshall Space Flight Center

Selected technological strengths: Materials; Manufacturing; Nondestructive Evaluation; Biotechnology; Space Propulsion; Controls and Dynamics; Structures; Microgravity Processing. Harry Craft (800) USA-NASA susan.van.ark@msfc.nasa.gov

Stennis Space Center

Selected technological strengths: Propulsion Systems; Test/Monitoring; Remote Sensing; Nonintrusive Instrumentation. Anne Johnson (601) 688-3757 ajohnson@ssc.nasa.gov

NASA Program Offices

At NASA Headquarters there are seven major program offices that develop and oversee technology projects of potential interest to industry. The street address for these strategic business units is: NASA Headquarters, 300 E St. SW, Washington, DC 20546.

Gene Pawlik
Small Business
Innovation Research
Program (SBIR)
(202) 358-4661
gpawlik@oact.hq.nasa.gov

Bill Smith
Office of Space Sciences
(Code S)
(202) 358-2473
wsmith@sm.ms.ossa.hq.nasa.gov

Robert Norwood
Office of Space Access
and Technology (Code X)
(202) 358-2320
rnorwood@oact.hq.nasa.gov

Bert Hansen
Office of Microgravity
Science Applications
(Code U)
(202) 358-1958
bhansen@gm.olmsa.hq.nasa.gov

Philip Hodge
Office of Space Flight
(Code M)
(202) 358-1417
phodge@osfms1.hq.nasa.gov

Gerald Johnson
Office of Aeronautics
(Code R)
(202) 358-4711
g_johnson@aeromail.hq.nasa.gov

Granville Paules
Office of Mission to
Planet Earth
(Code Y)
(202) 358-0706
gpaules@mtpe.hq.nasa.gov

NASA's Business Facilitators

NASA has established several organizations whose objectives are to establish joint sponsored research agreements and incubate small start-up companies with significant business promise.

Dr. Stephen Gomes
American Technology
Initiative
Menlo Park, CA
(415) 325-5353

John Gee
Ames Technology
Commercialization
Center
Sunnyvale, CA
(408) 734-4700

Jill Fabricant
Johnson Technology
Commercialization
Center
Houston, TX
(713) 335-1200

Dan Morrison
Mississippi
Enterprise for
Technology
Stennis Space
Center, MS
(800) 746-4699

NASA-Sponsored Commercial Technology Organizations

These organizations were established to provide rapid access to NASA and other federal R&D and foster collaboration between public and private sector organizations. They also can direct you to the appropriate point of contact within the Federal Laboratory Consortium.

Lee Rivers
National Technology
Transfer Center
(800) 678-6882

Dr. William Gasko
Center for Technology
Commercialization
(800) 472-6785 or
(508) 870-0042

Gary Sera
Mid-Continent
Technology Transfer
Center
Texas A&M University
(800) 472-6785 or
(409) 845-8762

Chris Coburn
Great Lakes Industrial
Technology Center
Battelle Memorial
Institute
(800) 472-6785 or
(216) 734-0094

Robert Stark
Far-West Technology
Transfer Center
University of Southern
California
(800) 642-2872 or
(213) 743-2353

J. Ronald Thornton
Southern Technology
Applications Center
University of Florida
(800) 472-6785 or
(904) 462-3913

Lani S. Hummel
Mid-Atlantic Technology
Applications Center
University of Pittsburgh
(800) 472-6785 or
(412) 648-7000

Easy Access To The FLC: Call (206) 683-1005 for the name of the Federal Laboratory Consortium Regional Coordinator in your area. The Regional Coordinator, working with the FLC Locator, can help you locate a specific laboratory to respond to your needs.

If you are interested in information, applications, and services relating to satellite and aerial data for Earth resources, contact: Dr. Stan Morain, **Earth Analysis Center**, (505) 277-3622. For software developed with NASA funding, contact **NASA's Computer Software Management and Information Center (COSMIC)** at (706) 542-3265, fax (706) 542-4807. If you have a questions...**NASA's Center for AeroSpace Information** can answer questions about NASA's Commercial Technology Network and its services and documents. Use the Feedback Card in this issue or call (410) 859-5300, ext. 245.

Adaptable Data Acquisition.



Datak —DT VEE
Product Mascot

With the industry's most **Flexible** interface, **DT VEE** **Graphical Programming** Software lets you control exactly the way your application looks and performs.

Our Graphical Programming Language makes it easy to change.

DT VEE offers intuitive programming to your test engineering applications through an incredibly flexible, graphical interface. While using its powerful "process blocks" you create high-level instruments with startling adaptability. Your major modifications appear as smooth transitions because there's no text based programming involved. What's more, you can choose to leverage your existing code because DT VEE's open architecture design provides standard ties to standard languages.

If that's not enough inspiration to change, DT VEE also supports multiple interfaces like GPIB, RS-232, DIO, and VXI based systems. This gives you the power to configure your data acquisition systems to your exact needs.

A Flexible GUI is a natural selection.

Flexibility is one of the most important features to consider while developing a functional test system. From the simplest instrument to the most complex, you need to alter your interface to suit a variety of applications and users. With DT VEE, new interfaces are created by simply highlighting, positioning, and sizing selected items in the user interface environment. Any combination of XY plots, frequency curves, bar graphs, needle meters, or alphanumeric displays can be incorporated with sliders, buttons, and toggle switches to customize your application more naturally.

It's that easy to create brilliant controls and displays.

With all this change, DT-Open Layers stays the same.

DT-Open Layers is a set of open standards for developing integrated, modular software under Microsoft Windows. Not only does it allow access to our hardware at the touch of a button, but it ensures support of all hardware upgrades and new functions for the future including those on standard PC busses like PCI, ISA and PCMCIA. That's why we call DT-Open Layers the insurance policy that comes with every Data Translation purchase.

There's a perfect metamorphosis that comes from standing behind the experts. So call us today, and watch your data acquisition come to life.

1-800-525-8528



DATA TRANSLATION®
For More Information Write In No. 530



World Headquarters: (508) 481-3700, UK Headquarters: (01734) 793838, Germany Headquarters: (07142) 95 31-0, Italy Headquarters: (030) 2425696.

Sales Offices: Argentina (1) 322-3791; Australia 02 979 5643, 03 350 7377; Austria 1 369 7660; Belgium (02) 569.56.47; Brazil 011-564-6024, (312) 915-3135; Canada (508) 481-3700, (416) 625-1907; China (1)-8331145; Denmark 48 14 14 88; Finland (0) 3511800; France (1) 69.07.78.02; Greece (1) 361-4300; Hong Kong 2515-0018; India (22) 231040; Israel 09-545685, 09-407352; Japan (03) 5489-3871; Korea (02) 718-9521; Malaysia (3) 261 6786; Mexico (5) 575-6091; The Netherlands 10-4795700; New Zealand (9) 415-8362; Norway (22) 43 41 50; Portugal (1) 7934834, (1) 7934934; Singapore 773 4300; South Africa (12) 803-7680; Spain (1) 555-8112; Sweden 08 765 02 80; Switzerland (1) 908-1313; Taiwan (62) 3039836; Thailand (22) 233-9836; Turkey (212) 288-6312, (212) 288-6215, (212) 274-9097 07/21/95



TO-5 RELAY TECHNOLOGY

HIGH SPEED DIGITAL SIGNAL SWITCHING?

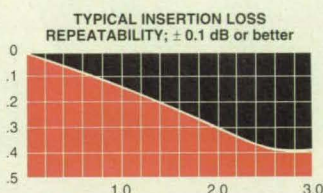


Use Teledyne's TO-5 Relays!

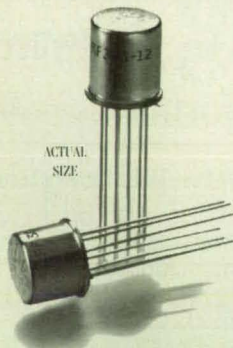
Relays whose enhanced performance meets the high speed edge rate and rise time requirements of digital switching applications. These relays are the sensitive coil 300 & 303 versions that provide unprecedented repeatability combined with high isolation and low insertion loss. The signal repeatability is ± 0.1 dB or better. We have provided enhanced performance by balancing the aggregate insertion loss elements of the relays' design.



Excellent for use in attenuators and other RF circuits, the RF300 and the RF303 feature outstanding signal repeatability over a broader bandwidth and a broader range of data rates than earlier TO-5 relays. Other significant features of these two relays include metal enclosures for EMI shielding, ground pin option to improve case grounding, high isolation between control and signal paths and high resistance to ESD.



These ultraminiature relays are housed in Teledyne Relays' TO-5 relay package measuring only 0.370 inch (9.40 mm) diameter x 0.275 inch (6.99 mm) high for the RF300 and 0.385 inch (9.78 mm) high for the sensitive RF303. High motor magnetic efficiencies and exceptional mechanical ruggedness results from internal welded construction and uniframe design. Contacts are gold plated precious metal alloy for low contact circuit losses and reliable switching. Coil voltages available are 5 and 12 volts.



For price, delivery or more technical information on unprecedented repeatability, call **1-800-284-7007** or Fax us at 1-213-779-9161.

- AUTOMOTIVE ELECTRONICS • AUTOMATIC TEST EQUIPMENT
- BROADCAST ELECTRONICS • MEDICAL ELECTRONICS
- TELECOMMUNICATIONS/WIRELESS
- TEST INSTRUMENTS & INSTRUMENTATION

TELEDYNE RELAYS
Innovations In Switching Technology

See these products in EEM 1995, Vol. B, Pages B. 1606-1609



Home Office: 12525 Daphne Avenue, Hawthorne, CA 90250.
Telephone: 213-777-0077 • FAX 213-779-9161

OVERSEAS: GERMANY +49 (0) 611-763-6147; ENGLAND +44 (0) 181 571-9596;
JAPAN (03) 3797-6956



New Product Ideas

New Product Ideas are just a few of the many innovations described in this issue of *NASA Tech Briefs* and having promising commercial applications. Each is discussed further on the referenced page in the appropriate section in this issue. If you are interested in developing a product from these or other NASA innovations, you can receive further technical information by requesting the TSP referenced at the end of the full-length article or by writing the Commercial Technology Office of the sponsoring NASA center (see page 14).

Garnet Random-Access Memory

Magneto-optical properties of magnetic garnets would feature magnetic writing and magneto-optical readout. Such memory devices would provide nonvolatile storage and would resist damage by ionizing radiation.

(See page 26.)

Low-Bandgap Thermovoltaic Materials and Devices

These devices would have relatively high energy-conversion efficiencies and would thus operate from cooler sources than the present thermovoltaic cells.

(See page 36.)

Imaging Magnetometer

A magnetometer is proposed for detecting underground structures that contain magnetic materials or underground machines that generate or alter magnetic fields. Images would be formed by magnetic deflection of an electron beam. The unit may be used for reconnaissance, inspections, or rescue operations.

(See page 40.)

Compact Multifunction Inspection Head

This multiple-sensor inspection head is designed to be mounted at the tip of a robot arm where it will perform multiple automated and/or remotely controlled inspection functions.

(See page 46.)

Device for Sampling Surface Contamination

A specially designed cotton swab is suitable for use in a cleanroom. Unlike ordinary swabs, this device does not shed cotton or wood fibers.

(See page 52.)

Bearing-Mounting Concept Accommodates Thermal Expansion

A design concept for mounting a rotary bearing accommodates differential thermal expansion between the bearing and any structure to which the bearing is connected. The objective is to prevent buildup of thermal stresses.

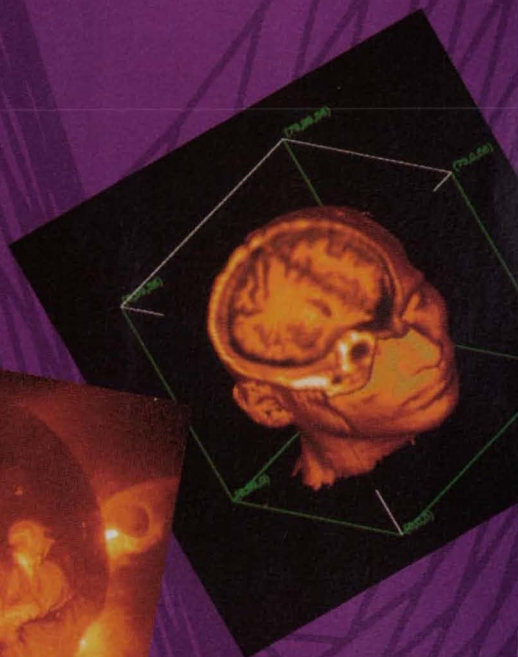
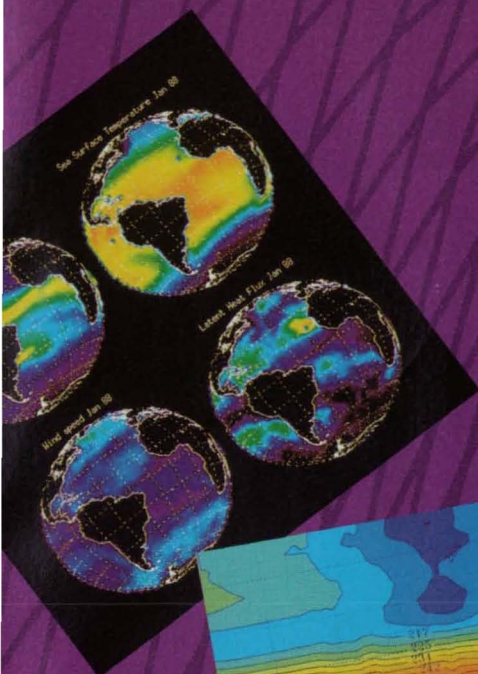
(See page 72.)

Parallel-Plate Acoustic Absorbers for Hot Environments

Stacking patterns and materials are chosen to suppress noise in hot-gas ducts. One application is in suppressing aerodynamic noise in the exhaust-jet mixer/ejector in the proposed High-Speed Civil Transport. It can also be adapted to other propulsion systems.

(See page 74.)

The Answers to Your Questions...



 **IDL**®

Immediately gain insight from your data with IDL, the pioneering software for interactive analysis and application development. If you analyze data from tests, experiments, simulations, or images — or write applications for others to use — IDL will give you clear results faster.

Dramatically improve your productivity using IDL for visual data analysis, rapid prototyping, or application development. Nothing else provides the speed, flexibility, and breadth of built-in functions for access, manipulation, and display of scientific and engineering data.

See results "on the fly" with integrated

graphics, image processing, mathematics, and statistics. Quickly turn your ideas into powerful applications using IDL's high-level, array-oriented programming language and cross-platform GUI tools.

A few lines of IDL code can do the job of hundreds of lines of C or Fortran, without sacrificing flexibility or performance. Plus, you can call functions in other languages or link IDL to your C or Fortran applications.

IDL programs are portable. You can deliver complete solutions on UNIX®, VMS®, Windows, Windows NT®, Macintosh®, and Power Macintosh, while writing programs only once.

So why waste time starting from scratch? Exploit IDL and find the answers — in less time, with less programming, and less hassle.

SEE THE ANSWERS FOR YOURSELF

For a free evaluation copy, call

303-786-9900

Email: info@rsinc.com/Fax: 303-786-9909

Software ≡ Vision.



Research Systems, Inc.

2995 Wilderness Place
Boulder CO 80301

Research Systems, Inc. is represented by the following distributors: **GERMANY** CREASO, GmbH 49 8105 25055 • **FRANCE** Fast Parallel Solutions 33 1 46 87 25 22 • **UK** Floating Point Systems UK Ltd. 44 734 776333 • **ITALY** Alliant Computer Systems SRL 39 39 6091766 • **JAPAN** Adam Net Ltd. 81 35802 2251 • **BRAZIL** SulSoft 55 51 488 22 57 • **KOREA** InterSys 82 42 869 4746

For More Information Write In No. 555

Denver International Airport (DIA), the biggest airport built in the past 20 years, opened on February 28, 1995 with most of the publicity centered around its automated baggage-handling system. But this state-of-the-art facility features another automated system that is serving passengers in a more critical way.

The Center TRACON (Terminal RADAR CONTROL) Automation System (CTAS)—an air traffic control automation system developed at NASA's Ames Research Center in the late 1980s—is DIA's primary traffic management tool. Components of CTAS are in use at all three of the airport's air traffic control facilities: Enroute Center at Longmont, CO; terminal radar control; and the airport tower.

CTAS is a software-based technology designed to efficiently manage and control arrival traffic at multi-runway hub airports by automating the process. It is comprised of a Traffic Management Advisor (TMA), a Descent Advisor (DA), and a Final Approach Spacing Tool (FAST). Only the TMA has been put into operation at Denver. The other two elements are being prepared for testing at Denver and Dallas/Fort Worth airports.

CTAS was brought to the attention of a traffic management coordinator from Denver's Stapleton Airport when he attended a demonstration of the system



Denver International uses CTAS to help controllers manage air traffic more efficiently. CTAS data is displayed via overhead projectors, allowing controllers to view the information while working at their radar stations.

at NASA Ames. At the time, Stapleton controllers were receiving information on incoming air traffic by phone from Denver's air traffic management center, so CTAS provided an attractive alternative.

In May 1993, Stapleton began testing CTAS, and although the equipment operating the system at the airport was outdated, the personnel using CTAS were impressed with its performance and capabilities. The input provided by the Stapleton team proved invaluable to NASA's development efforts, allowing Stapleton to continue using CTAS.

Prior to transferring CTAS to the new

airport, the system had to be modified to allow for the increase in air traffic and number of arrival/departure gates, as well as the larger number of workers who would be using it at DIA. Additional workstations were added, as were overhead screens to display CTAS data for controllers working at their radar stations.

A "Thinking" System

The CTAS software contains a database of the aerodynamic and propulsion system characteristics and performance limits of most aircraft; the database requires updating as new aircraft are developed. In addition, it contains real-time gridded models of winds, temperatures, pressures, arrival routes, landing runway configurations, aircraft separation constraints, and landing capacity.

CTAS goes into action when it receives radar tracking data for an aircraft, or when air traffic is about 45 minutes (flying time) from the airport. As the aircraft approaches, CTAS scans the database and the TMA selects the best descent route and earliest available landing time based on the type of aircraft, weather conditions, and competing flights. The system is endowed with cognitive qualities that allow it to react and adapt continuously to unplanned events such as missed clearances and changing weather.

When it is operational, the Descent

Fewer Flight Delays In Your Future

NASA's Langley Research Center has completed a flight demonstration of airport automation concepts that could safely increase traffic capacity on airport runways and taxi surfaces. Flight crews would be provided with the status of ground traffic in addition to air traffic control instructions. Ground controllers would receive information on airport surfaces traffic 24 hours a day, in all types of weather.

The tests, conducted using NASA's Boeing 737 at the FAA Tech Center at the Atlantic City International Airport in New Jersey, are part of NASA's Terminal Area Productivity (TAP) program—a seven-year initiative started in 1994 to increase airport capacity and reduce passenger delays.

An air traffic controller with a data link between the control tower and the aircraft sent approved taxi routes and hold instructions to the aircraft. The controller's information was displayed on an electronic mov-

ing map onboard the aircraft. Airport traffic positions obtained from ground surveillance radar were sent to the aircraft as well. The plane was equipped with onboard data and video equipment and a video telemetry link, which allowed ground officials to see aircraft movements on the taxiways—as well as cockpit activities—as they occurred.

Test results showed that advanced communications, navigation, and surveillance technologies can provide significant improvements in airport ground operations, and enhanced efficiency and safety can be achieved with automation by reducing human error and minimizing pilot and controller workload.

For more information, contact Ron Harvey, Langley Research Center: 804-864-6527.

Advisor will generate a sequence of advisories to take the aircraft from its current position and altitude to the feeder gate at a specified crossing time. When the aircraft crosses the gate and is tracked by the terminal radar, FAST will begin planning the aircraft's landing by first calculating runway allocation, assigning a sequence number for its landing order, and displaying speed and heading advisories using color-coded symbols on the flight controller's monitor. This process would be repeated periodically for all aircraft until they reached their final approach.

"CTAS does not replace controllers, but rather, 'thinks' along with them in solving traffic problems, and assists the controller in achieving a solution by means of special computer-human interfaces," explained Dr. Heinz Erzberger, senior scientist for air traffic control at NASA Ames. "The difference between conventional air traffic control systems and CTAS is the difference between seeing and perceiving. Conventional systems are designed to help controllers see traffic by collecting, processing, and displaying sensor information." CTAS, on the other hand, has the ability "to perceive the flow of traffic simultaneously and in real time in the entire arrival airspace," said Erzberger.

Mike Moss, assistant manager for air space and procedures at DIA, said that the greatest advantage of the NASA system is its ability to provide more detailed data. CTAS allows users to set up graphs depicting spacing for both large jets and small commuter planes and view time lines to anticipate heavy traffic. Arrival rates at DIA can equal up to 135 aircraft per hour, and the facility experiences air traffic "peaks and valleys." CTAS has been able to successfully manage the heavy, fluctuating traffic. CTAS also provides controllers with about one hour of advance notice to reroute air traffic due to approaching weather changes. The system's capabilities, according to Moss, have provided DIA with an additional way to use CTAS: training new personnel.

DIA has formed a system development and design team to assist NASA in developing both the Descent Advisor and the Final Approach Spacing Tool. Future plans call for the components to be installed at major hub airports across the nation. Dr. Erzberger estimates that if CTAS were implemented nationwide, airlines would save about a billion dollars per

year, mostly from reductions in delays (up to 40% during peak traffic) and fuel costs (100 to 250 pounds per aircraft during descent). The full benefits of CTAS will not be realized until all three components of the system are put in operation as a unit.

"Our work here at NASA, done cooperatively with the FAA and industry, is fostering

a revolution in air traffic management," Dr. Erzberger said. "We are beginning to see the payoff in both safety and efficiency."

For more information on CTAS, contact Dr. Heinz Erzberger, Flight Systems Research Laboratory, Mail Stop 210-9, NASA Ames Research Center, Moffett Field, CA 94035-1000; Tel: 415-604-5425.

THE EVANS

CAPATTERY



Power. When you need it. Whenever you need it.



P.O. Box 4158, East Providence RI 02914
(401) 434-5600. Fax (401) 434-6908.

The Evans Capattery. Very small, very powerful, very reliable.



* PATENTED

This incredible double-layer capacitor is a unique carbon-based device that is housed in a welded tantalum package.

Its patented Permselective valve allows it to release CO₂ generated during normal operation while inhibiting the escape of electrolyte vapors and preventing contaminants from entering the container.

A 5.5-volt, 1F Capattery has a volume of 0.5 in.³, an 11-volt, 0.5 F Capattery has a volume of less than 1 in.³.

The Capattery has a temperature range of -55°C to 85°C. It withstands unlimited charge/discharge cycles.

Marshall Space Flight Center

When rocket engineer Wernher von Braun and colleagues came to the Army's Redstone Arsenal in Alabama in the 1950s to develop rockets for the Ballistic Missile Agency, they set the precedent for space transportation and propulsion development that continues on the site today. Their Jupiter-C vehicle gave birth to the US space program by launching America's first satellite in 1958. Two years later, the team formed the nucleus of NASA's new Marshall Space Flight Center.

In 1961, Marshall's Redstone rocket put the country's first astronaut, Alan Shepard, into space. By then, the center's engineers already were testing the multi-engine Saturn rockets, which hurled the Apollo 11 crew to their historic mission in 1969. In the 1970s, Marshall supplied the Skylab workshop and many of its experiments, as well as the project's four Saturn rockets.

Today, the center provides the space shuttle's three main engines, the external fuel tank, and the two solid-fuel boosters. It has contributed to space science by developing the three High Energy Astronomy Observatories, the Hubble Space Telescope, and the Advanced X-Ray Astrophysics Facility, and manages most Spacelab missions. For the International Space Station, Marshall is providing test, manufacturing, and assembly support and the Furnace Facility for microgravity materials research, and will manage payload operations and utilization. The center continues to advance rocket propulsion research, serving as NASA's host center for the reusable launch vehicle (RLV) program designed to supersede the space shuttle.

Operations and Facilities

Such undertakings require vast resources—more than 8000 civil servants and contractor employees on 1841 acres within the Redstone Arsenal. The Propulsion Laboratory consists of a complex of engine test stands, laboratory buildings, and other facilities, and supports virtually every aspect of rocket engine research, design, development, and testing. Engine innovation requires several teams that pursue crucial subdisciplines. For propulsion diagnostics, the combustion physics team develops tech-

niques—mostly laser—to measure conditions within the combustion chamber, nozzle, and plume, and to detect hydrogen leaks. The trajectory team analyzes current and proposed launch vehicles for ascent performance, providing simulations from liftoff to main engine cutoff. The cryogenic space propulsion and booster engine design teams develop upper-stage, manned interplanetary, and Earth-to-orbit engine systems.

Marshall facilities provide testing of numerous engine components. The 406-foot Advanced Engine Test Facility can provide static firing of up to 7.5 million pounds of thrust. Test Facility 500 is designed for hazardous testing of liquid oxygen and LH2 aerospace subsystems and components. The Hydrogen Cold Flow Facility conducts LH2 testing at high flow rates, and also is suitable for testing other kinds of cryogenics and fluids. The Hot Gas Facility, for testing thermal protection systems, closely simulates flight-condition values for heating rates, local pressure, acoustics, and duration.

The Materials and Processes Laboratory runs the five-building Productivity Enhancement Complex (PEC), a focal point of cooperative research between Marshall and contractors. For composites research, several methods are investigated for advanced structures and manufacturing: pultrusion, by which parts are formed by pulling fibers through a die; fiber placement, to build parts in complex 3D shapes; filament winding; and tape laying and wrapping. Researchers in the Vacuum Plasma Spray cell develop new coatings using low pressure and inert gas to produce metallurgical bonds between materials. Welding—highly critical to many of the center's products (the space shuttle's external tanks have a mile of welds)—forms the focus of extensive research at Marshall. Other PEC facilities are available for investigating new sealants, paints, and insulation that offer improved performance and decreased environmental impact.

Robotics at Marshall is covered both in the PEC—in its gantry and articulated-arm robotics cells—and in the Astrionics Laboratory's Robotics Facility, with its 4000 square-foot precision-cast epoxy floor ("the world's flattest floor," accord-

ing to Marshall) for simulating weightlessness in the x, y, and roll axes. Astrionics also has a flight simulation laboratory to integrate and verify flight hardware and software, an antenna range for measuring spacecraft antenna performance from 200 MHz to 60 GHz, an audio development and test facility, electrical power-system testing facilities, and an optical fabrication shop.

The Structures and Dynamics Laboratory maintains facilities for disparate disciplines from control systems and stability to fracture mechanics and vibroacoustics: fluid flow facilities for testing internal flow dynamics; large and small structural test facilities for static and dynamic testing; and wind tunnels for quick-response testing. The Systems Analysis and Integration Laboratory has the Natural Buoyancy Simulator Facility, providing weightlessness for studies of new hardware and procedures, such as spacecraft servicing; the X-Ray Calibration Facility, for x-ray optics development; the Environmental Test Facility, for thermal, vacuum, outgassing, and humidity tests on space systems; and the Environmental Control and Life Support System testbed for developing and integrating space station subsystems. The Space Sciences Laboratory, with a strong astrophysics and Earth sciences emphasis, has a crystal growth furnace for studying growth of technologically important materials in space. And the Missions Operations Laboratory, dedicated primarily to mission planning and support, hosts a space station mock-up for engineering research.

Distributing the Goods

With 60% of its on-site workers employed by Marshall contractors, 20,000 more contracted employees off-site, and about 500 research and development contracts in effect at one time, the center has substantial experience in partnering with industry. The Technology Transfer Office (TTO) handles thousands of requests for assistance each year. In fact, after the center signed memoranda of understanding with nearby states—Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North and South Carolina, and Tennessee—the number of requests for assistance from

industry skyrocketed from 27 in 1989 to more than 2000 in 1994.

Marshall maintains close contact with local chambers of commerce and state development agencies, assigning one civil service engineer and one contractor engineer to assist each state in the region. These teams visit businesses that have expressed interest in problem-solving or accessing NASA technology. Problems disclosed during the visit are written up and submitted to the TTO's Technology Applications Board, which evaluates the statement and usually forwards it to the appropriate Marshall (or other NASA) laboratory for resolution. The teams also conduct symposia and seminars for industries. To share the workload and eliminate redundancy in their overlapping territories, Marshall, Stennis Space Center, and Kennedy Space Center formed a Southeast Regional Alliance for transferring NASA benefits to area industry.

A common form of cooperation at Marshall—with several hundred requests per year—is the Technical Assistance Agreement, a one-page application designed for industry, but also accepted from individual entrepreneurs, universities, and other research organizations. The dynamic program moves technology quickly with minimal effort from the applicants. The TTO considers requests for information on a specific technical field and for help with industrial or technical problems, or proposals for cooperative research projects.

Marshall enters into a full range of joint agreements, from simple letters of agreement involving a small amount of manpower or use of unique Marshall laboratory or test equipment, to larger agreements involving greater resources and longer lead times. The TTO will negotiate with prospective partners on the amount of resources to be contributed by each party, proprietary questions, and patents and licensing.

The TTO manages Marshall's Technology Reinvestment Program projects, coordinating development of "dual-use" technologies that have both commercial and military applications. (These increasingly available projects are funded by the Department of Defense.) The TTO manages a newer, similar program—the Aerospace Industry Technology Program—funded by NASA to stimulate US economic growth through high-payoff, high-risk technologies that will lead to commercial products that may also benefit NASA missions. The office also assists businesses in exploiting the commercial potential of space through the Marshall-pioneered Joint Endeavor Program, which enables

experimentation in the space shuttle and space station.

Getting Results

Access to Marshall's unique facilities often has made the difference in a make-or-break situation. One small company could not locate in the private sector the test facilities it required, and approached Marshall. The center designed the test procedure to simulate the takeoff, landing, and altitude effects on a new environmental duct for large aircraft, enabling the firm to market its product. Both industry and government researchers have used Marshall's Advanced Computed Tomography Inspection System many times to test the efficiency of large-scale industrial scanning.

Many companies also have benefitted from Marshall's welding expertise. One firm in Tennessee had a problem in a welding process for recycling 55-gallon drums. Marshall demonstrated a system that could be automated, with which the company saved \$240,000 per year at its two plants.

The center has taken a special interest in the physically challenged. As part of an

amputee assistance program begun in 1988 when a former Marshall engineer lost his left hand, a team designs low-cost prosthetic devices, which are attached by a quick-disconnect feature. A woman who lost an arm to a crocodile received one of the devices in 1993, enabling her to perform daily activities (see *NASA Tech Briefs*, September 1994, p. 25). In response to a rehabilitation official's request, Marshall engineers solved a design problem in a water ski for wheelchair-bound persons. As a result, the ski was used to win a water skiing championship. A prosthetics manufacturer, revamping its master-mold-producing process, turned to Marshall for a foam designed for space shuttle insulation that was lighter, less brittle, and more easily repaired than the previous plaster-of-paris material.

In another spinoff, a Marshall engineer invented the Power Factor Controller to match voltage to need in electric motors—a concept spun-off to products like the Electra-Miser™ power conservation device for typewriters, washing machines, and other appliances, marketed by M.H. Marks Enterprises of Pittsburgh, PA, and a motor starter designed by Intellinet Corp. in Baltimore, MD. Marshall technology also supplied the ICEMAT, a mat of flexible tubing for ready-made ice-skating rinks; an "S Glass" yarn that can withstand extreme temperatures and pressures for valve packing; and a new lightweight aluminum-lithium alloy, invented for the space shuttle external tank, that is expected to be commercially available by 1998 for ships, wheelchairs, bicycles, and auto parts.

For more information on facilities and opportunities at Marshall, contact Harry Craft, Manager, Technology Transfer Office, Code LA20, Marshall Space Flight Center, Huntsville, AL 35812; Tel: 1-800-USA-NASA; Fax: 205-544-1815 or 205-544-3151.



Marshall's Advanced Computing Tomography Inspection System (ACTIS) for large-scale industrial scanning is used by government agencies and private sector researchers. The Department of Agriculture uses ACTIS to scan trees for embedded nails or spikes that would damage saw blades if undetected before cutting.



► Microbolometers Based on Epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Thin Films

These devices exhibit high sensitivity and low noise.

NASA's Jet Propulsion Laboratory, Pasadena, California

Improved microbolometers of the superconducting-transition type are being developed with a view toward the eventual fabrication of staring, infrared-imaging planar arrays of such microbolometers integrated with addressing electronic circuitry. The development of these microbolometers builds upon the prior development of similar microbolometers in which the superconducting thin films that serve as the sensing elements are not epitaxial. The superconducting thin films in the present microbolometers are epitaxial, and this confers an advantage, as explained below.

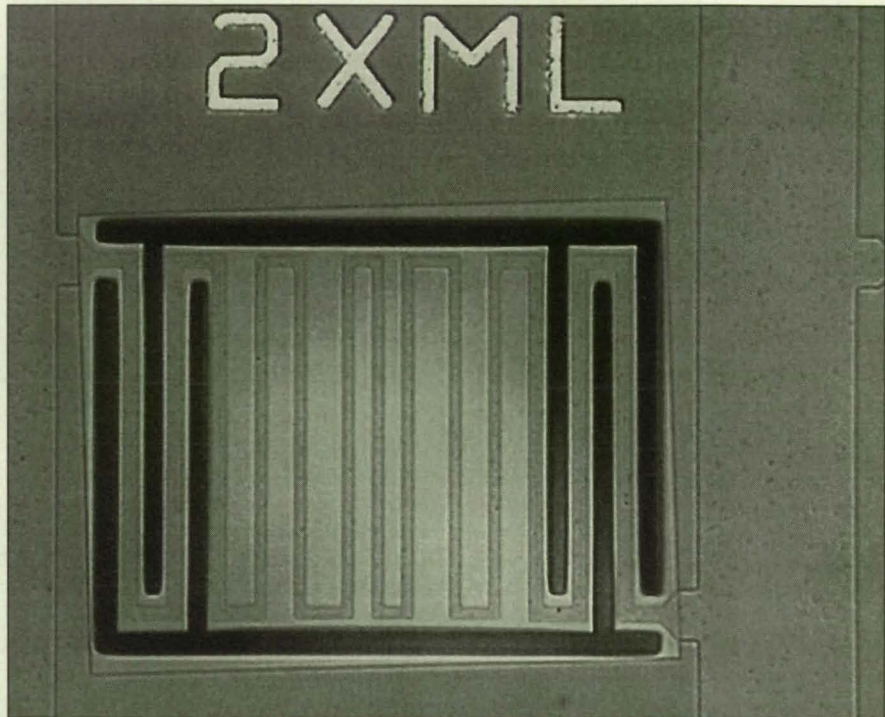
In a superconducting-transition bolometer, the sensing element is a thin film of superconductive material mounted on a thin substrate maintained at an equilibrium temperature in the vicinity of the superconducting-transition temperature (T_C). In this temperature range, the electrical resistance of the film varies sharply with temperature from the finite resistance of normal conductivity above T_C to the zero resistance of superconductivity below T_C . The sharpness of this transition can be exploited by using it to measure incident infrared radiation via the slight heating effect of this radiation on the sensory film. The temperature rise and thus the bolometric sensitivity can be maximized by thermally isolating the sensing element. Device speed is improved by making the sensing element and substrate thin to minimize thermal mass.

In fabricating a microbolometer of the previous type, a layer of the high- T_C superconductor $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ is deposited on a layer of yttria-stabilized zirconia (YSZ) that has previously been deposited on an underlayer of Si_3N_4 . The YSZ layer is needed to prevent chemical reactions between the Si_3N_4 and $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layers. Because Si_3N_4 is amorphous in the sense that it lacks crystalline structure, the YSZ and $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layers are polycrystalline or, to state it alternatively, they lack the

desired epitaxial single-crystal structure. As a result, the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film exhibits a relatively broad resistance-vs.-temperature transition instead of the sharp transition that is needed for high sensitivity and that could be achieved in an epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film. Furthermore, the grain boundaries of the polycrystalline $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film create excess electrical noise.

sor structure and thereafter serves as the lower layer of this membrane.

After deposition of the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film on the YSZ film on the Si substrate, the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ is ion-milled into a meandering pattern. A cap layer of Si_3N_4 is deposited to form the primary supporting layer of the membrane and to protect the top side of the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ during the final etch. Then, windows are



This **Superconducting Transition-Edge Microbolometer** is 140 by 105 μm in size and has a noise equivalent power of $1.5 \times 10^{-12} \text{ W/Hz}^{1/2}$ and a thermal time constant of 105 ms. The central absorbing area and narrow legs are 1- μm thick membranes suspended over an etch pit in the silicon substrate. The dark lines represent via holes cut through the films to allow the chemical etching solution to attack the underlying silicon.

In fabricating a microbolometer of the improved type, an epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film is obtained by depositing $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ on a YSZ buffer layer that is, in turn, epitaxial with a silicon substrate. The YSZ layer protects the underside of the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film from a KOH solution that is used subsequently to etch out a volume of silicon from underneath to create a membrane sen-

opened through the Si_3N_4 and YSZ to allow the KOH solution to attack the underlying silicon.

A microbolometer (see figure) fabricated from epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ films has shown a detectivity of $D^* = 8 \times 10^9 \text{ cm}\cdot\text{Hz}^{1/2}/\text{W}$ at 2 Hz and a temperature of 80.7 K. This value of D^* exceeds the

(continued on page 26)

Get the inside track on

performance.



MSC/PATRAN Release 1.4 and the HP 9000 J-Class Model J200.



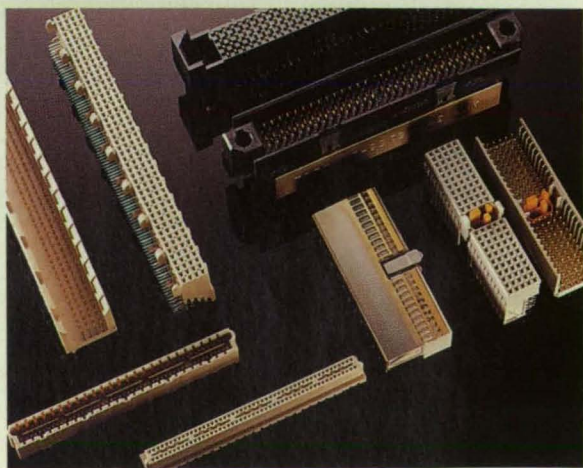
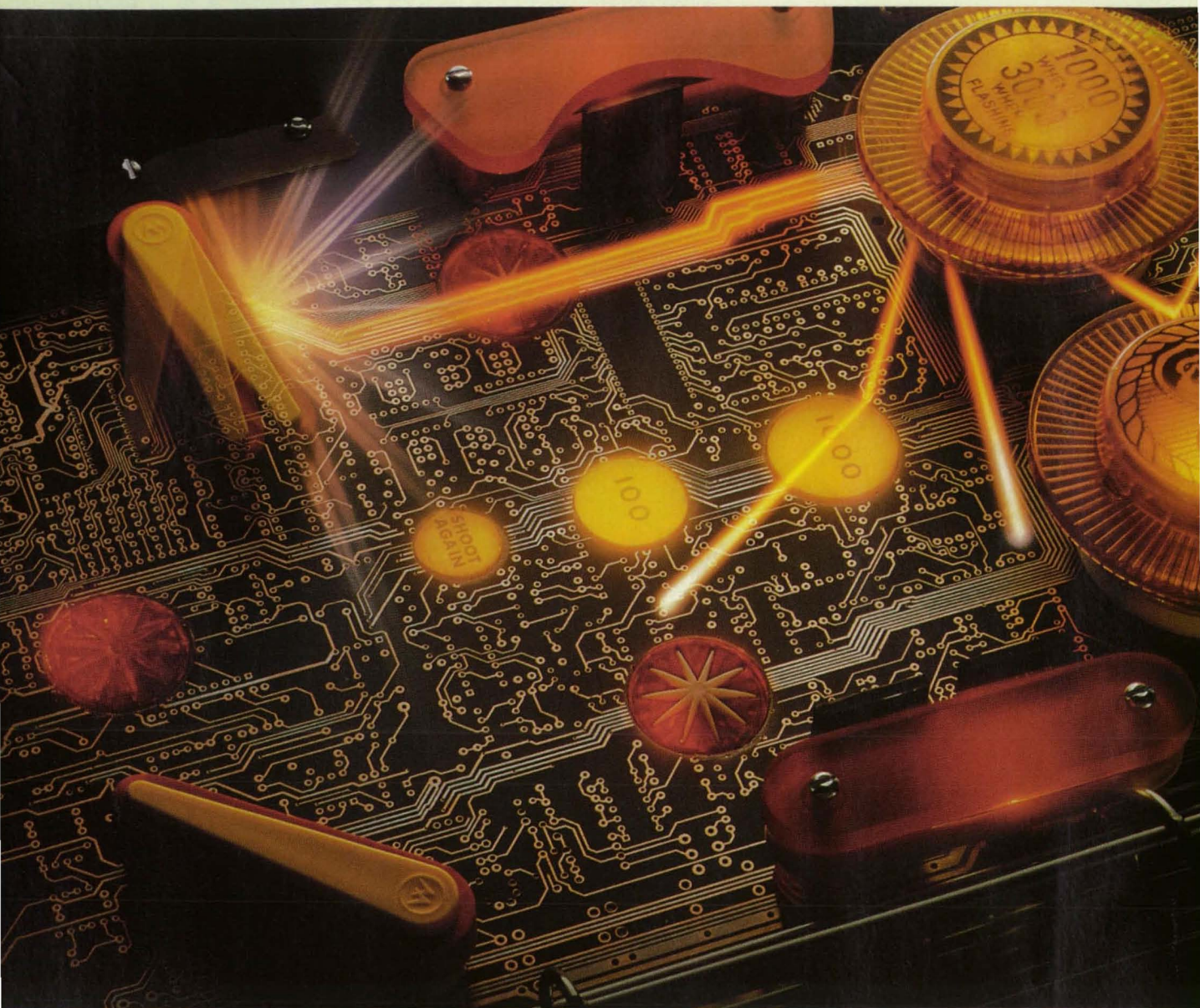
Release 1.4 of MSC/PATRAN brings exceptional gains in performance to analysts and designers – graphics speed a full 10 to 20 times faster – dramatically improved performance and simplicity of direct CAD geometry access – and greatly enhanced integration with MSC/NASTRAN, including support for p-elements and superelements. No other CAE software has the combination of high performance and power integration as Release 1.4 of MSC/PATRAN.

For ultimate productivity, add the no-compromise, full computing power of the Hewlett-Packard 9000 J-Class Workstation Model J200. It provides the best features of HP's high performance PA-RISC processors in a dynamic new system package. Get the inside track on breathtaking performance with MSC and Hewlett-Packard. For MSC information, call 800-642-7437, ext. 2500 or visit MSC's website at <http://www.macsch.com>. For more information about Hewlett-Packard products, call 800-637-7740, or visit the HP website at <http://www.hp.com>.



The
MacNeal-Schwendler
Corporation

*At fast edge rates, the wrong interface
takes on unexpected qualities.*



*AMP high-speed connectors – in hard metric,
shielded hard metric, Futurebus, stripline, and
microstrip versions – offer a broad range of
signal management solutions.*

AMP high-speed board-to-cable connectors and cable assemblies minimize reflection, crosstalk, and propagation delay at critical interfaces.



As the demand for performance pushes clock rates up, signal integrity can become a real challenge—especially when traffic moves from board to board, or board to cable. Interconnects that worked last time around suddenly act a lot like bumpers and flippers when your signal hits them. Fortunately, expert interconnect help is available.

We'll show you a broad range of technology solutions—the newest and best of subnanosecond interfaces. We'll work with you to choose the right combination of performance and features to meet tough circuit requirements. And our experience in design and in manufacturing can help make sure your choice works on the production line, as well.

Our high-speed and controlled-impedance interconnect solutions are engineered for hassle-free implementation, even with edge rates pushing 250ps. Our board-to-board selection includes high-



density open pin field types (shielded versions available), plus stripline and micro-strip styles that allow you to match characteristic board impedances to minimize crosstalk, reflection, and groundbounce. Our board-to-cable selection includes precision miniature coax and transmission line offerings to maintain signal integrity with minimum propagation delay.

And we offer the simulation tools you need to confirm performance in software, before you build your first prototype. Talk with your AMP Sales Engineer today, or call; we're ready to help.

AMP is a trademark.

Connecting
at a
HIGHER
level.

For more information on AMP signal management solutions, call our Product Information Center at 1-800-522-6752 (fax 717-986-7575). AMP Incorporated, Harrisburg, PA 17105-3608. In Canada, call 905-470-4425.

For More Information Write In No. 549

AMP

(continued from page 22)

highest previously reported D^* for a $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ transition-edge bolometer and is comparable to the highest D^* for a thermal detector operating at temperatures of 80 K or higher. Linear arrays of such devices show a uniformity in

response of about ± 10 percent among working devices, although the current yield is less than 50 percent.

This work was done by Marc C. Foote and Brian D. Hunt of Caltech and Burgess R. Johnson, and Holly A. Marsh

of Honeywell, Inc., for NASA's Jet Propulsion Laboratory. For further information, write in 24 on the TSP Request Card. NPO-19251

Garnet Random-Access Memory

Magnetic writing and optical readout would be used.

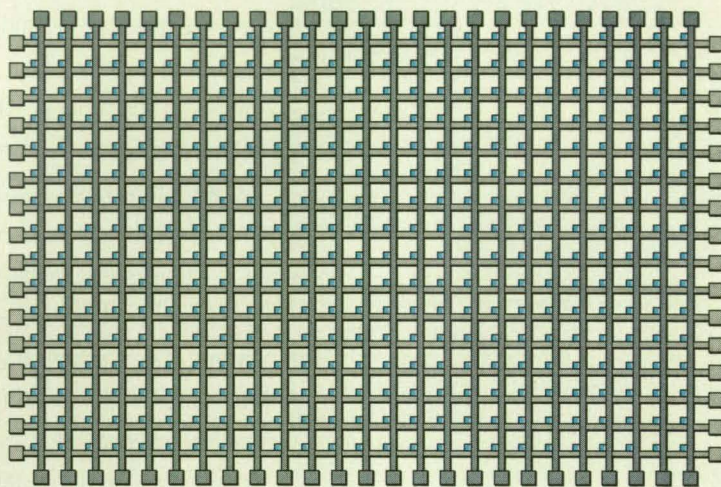
NASA's Jet Propulsion Laboratory, Pasadena, California

Random-access memory (RAM) devices of a proposed type would exploit the magneto-optical properties of magnetic garnets [for example, yttrium iron garnet (YIG)] that exhibit perpendicular anisotropy. These memory devices would provide nonvolatile storage and would resist damage by ionizing radiation. Because of basic architecture and pinout requirements, these RAMs would most likely be useful as small-capacity memory devices.

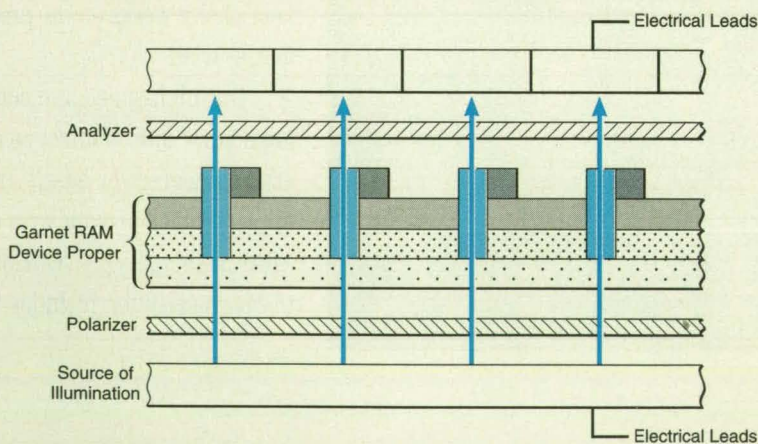
A RAM of this type would comprise a rectangular array of memory cells containing garnet storage films between column and row conductors (see figure). To store a bit in a cell, current of appropriate magnitude and polarity would be applied to the row and column conductors that intersect at that cell to magnetize the garnet film in either of two binary states (up or down, representing 1 or 0, respectively). The bit state of a cell would change only when the particular cell was selected and the row and column currents exceeded threshold values. The magnetization states of the cells, and thus the data stored in the memory device, would remain when power was turned off; that is, storage would be nonvolatile.

Readout would be accomplished optoelectronically. For example, light from a lamp, array of laser diodes, or another source would be sent through a polarizer, then through the garnet RAM, then through an analyzer (another polarizer), finally impinging on an array of photodetectors, each of which would be positioned to receive the light that passed through one memory. The polarization of the light in each cell would be rotated by an amount dependent on the magnetization state, affecting the intensity of transmitted light and thus the output of the photodetector for that cell.

This work was done by Romney R. Katti of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 49 on the TSP Request Card. NPO-19342



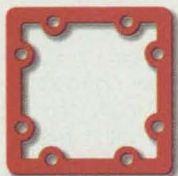
TOP VIEW OF MEMORY DEVICE WITHOUT READOUT CIRCUITRY



MAGNIFIED, EXPLODED SIDE VIEW OF PART OF MEMORY DEVICE WITH READOUT CIRCUIT

A **Garnet RAM Device** would feature magnetic writing and magneto-optical readout. Because garnet is an electrical insulator, row and column conductors could be placed directly in contact with the garnet storage films, minimizing switching currents, power dissipation, and memory area. Spacing would be designed to optimize storage density with acceptably low cross-writing. The specific type of garnet would be chosen, according to its properties, to optimize switching characteristics, drive current, and power dissipation.

OUR LASER IS WELL KNOWN AROUND THESE PARTS.



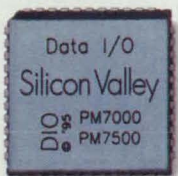
Gasket Manufacturing



*Color Marking on
Anodized Aluminum*



Engraving Wood



Marking Microprocessors



Cutting Plexiglas



Cutting Paper



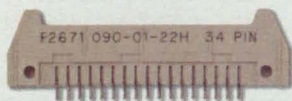
Wire Stripping



Textile Cutting



Cutting Wood



Marking Plastic



Cutting and Welding Plastic



Rubber Stamps

And the list doesn't stop here. The more manufacturers get to know our RF-excited, sealed CO₂ lasers, the more uses they keep finding for them.

This growing popularity makes sense when you consider how versatile and cost-efficient our lasers can be. All the parts shown here were marked or cut in seconds or less – in some cases while moving on high speed production lines.

No tooling is required. The laser's power and motion are controlled using a simple PC. Images, graphics, and text can be created in standard CAD or graphics software – delivering



greater process flexibility. Changing the pattern is as simple and quick as loading a new computer file.

Plus, the laser's small focused spot and non-contact approach eliminate the use of dies, blades, scribes or ink. So you can expect increased accuracy, resolution and process savings.

We offer models from 10 to 250

watts of power, allowing you to select the laser that matches your application and budget. And, as they all take advantage of our patented all-metal construction, you get over

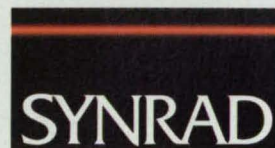


20,000 hours continuous operation.

With no gas bottles or other consumables. That's why Synrad lasers cost less to buy and run than any other models.

If you don't recognize your application on this page, don't worry. Our biggest customers had never used a laser before talking to us.

To find out how lasers can take part in your application, call (800) SYNRAD1.



11816 North Creek Parkway N., Bothell, WA 98011-8205 (206) 483-6100 FAX (206) 485-4882 E-mail: synrad@aol.com

International Representatives

Australia 61 (376) 15200. Belgium 32 (71) 488-44-8. China 86 143-658-91. Denmark 45 (354) 30133. England 44 (1295) 267755. France 33 1-60.79.59.00. Germany 49 898-90-1350. Greece 30 312-045-50. Hungary 36 1-269-0105. Israel 972 9574111. Japan 81 (33) 758-1111. Netherlands 31 17243-1234. Poland 48 224-318-02. Singapore 65 382-2633. Spain 34 1-35.88.61.1. Sweden 46 87-569-190. Turkey 90 2-122-63-2670.

For More Information Write In No. 538



Fabrication of SNS Weak Links on SOS Substrates

A multilayer buffer system makes it possible to form high-quality epitaxial SNS weak links.

NASA's Jet Propulsion Laboratory, Pasadena, California

High-quality superconductor/normal-conductor/superconductor (SNS) devices ("weak links") that contain epitaxial films of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and SrTiO_3 can be fabricated on silicon-on-sapphire (SOS) substrates with the help of an improved multilayer buffer system. The improved multiple buffer layers overcome major obstacles that have been encountered in previous efforts to fabricate such devices, as explained below.

High-quality epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and SrTiO_3 films are essential for SNS edge-defined weak links. For reasons that are beyond the scope of this article, it is necessary to deposit these films on buffer layers of epitaxial cubic zirconia (also known as yttria-stabilized zirconia, abbreviated "YSZ") on SOS substrates. In previous research, it was found that $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ films grown directly on YSZ are not suitable because BaZrO_3 reaction layers are formed at the $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ /YSZ interfaces and these reaction layers, in turn, nucleate grain boundaries in the edge-junction counterelectrodes. The formation of grain boundaries can be prevented by fabricating the SNS devices on SrTiO_3 buffer layers, but it has not proven possible to grow epitaxial SrTiO_3 directly on YSZ, silicon, or SOS substrates. For these reasons, deposition of structures like that at the top of the figure, according to the prior art, has yielded $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ films that are nonepitaxial

and that are not superconducting at temperatures above 10 K and are thus unsuitable for SNS devices.

The improved multilayer buffer system includes a seed layer of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ between the YSZ and SrTiO_3 layers. The $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ seed layer greatly improves the epitaxial quality of the SrTiO_3 layer and of the main $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layer deposited on top of the SrTiO_3 layer. The seed layer was nominally 100 Å thick in the first demonstration of this concept, but could be made thicker. Alternatively, the seed layer could be made of $\text{PrBa}_2\text{Cu}_3\text{O}_{7-x}$ or another compound analogous to $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$. The $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ seed layer produces the desired effect because, notwithstanding the reaction-layer problem, high-quality epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ can be grown on YSZ. The epitaxial seed layer then serves as a template for epitaxy of the SrTiO_3 layer.

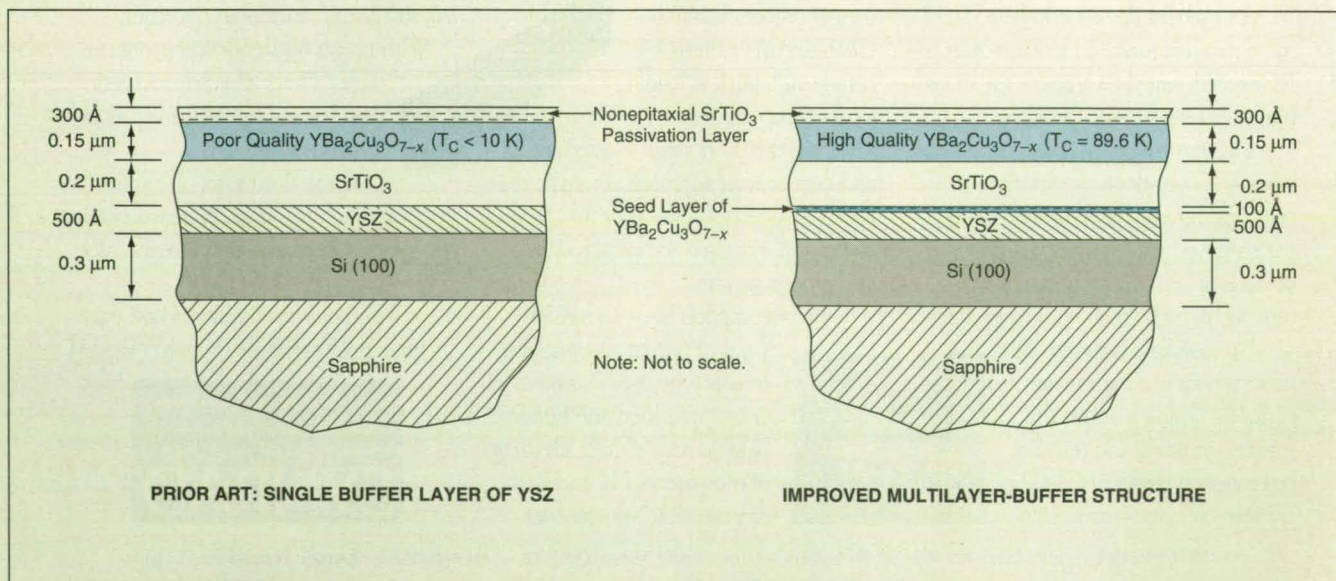
In preparation for growth of the buffer layers, SOS substrates are cleaned by use of an HF/ethanol mixture. The YSZ layers are grown by pulsed-laser deposition from a YSZ target in oxygen at a pressure of 1 millitorr (0.13 Pa) and at a temperature between 775 and 825 °C. The $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$, $\text{PrBa}_2\text{Cu}_3\text{O}_{7-x}$, or other seed layer is then grown to a thickness of 100 to 300 Å by pulsed-laser deposition in 50 to 500 millitorr (6.7 to 67 Pa) of oxygen at nearly the same temperature.

The temperature is then typically

adjusted to ≈ 760 °C, and the oxygen pressure changed to 120 millitorr (16 Pa) for pulsed-laser deposition of the thick SrTiO_3 layer. Finally, the temperature is returned to a value between 775 and 825 °C, the oxygen pressure is returned to a value between 50 and 500 millitorr, and the main $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layer (possibly doped with La) is grown by pulsed-laser deposition. This $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layer serves as the base electrode for fabrication of the edge-geometry SNS weak link. In some cases, this multilayer structure is capped by a thin nonepitaxial SrTiO_3 film, grown near room temperature, which serves as a passivation layer.

The process for fabrication of edge-defined SNS weak links was described in "Edge-Geometry SNS Devices Made of Y/Ba/Cu" (NPO-18552), NASA Tech Briefs, Vol. 17, No. 10 (October, 1993), page 50. SNS devices with the improved multilayer buffer structure shown in the lower part of the figure have been fabricated with $\text{PrBa}_2\text{Cu}_3\text{O}_{7-x}$ and, alternatively, with codoped $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ as the normally conducting metals. The performances of these devices were found to be superior to those of edge-defined weak links fabricated directly on YSZ buffer layers.

This work was done by Brian D. Hunt of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 62 on the TSP Request Card. NPO-19306



The **Improved Multilayer-Buffer Structure** makes it possible to deposit a high-quality epitaxial $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ layer that exhibits a high superconducting-transition temperature (T_C).



Got a little project?
Turbo ZX.[™] For shockingly fast repaints.

Presenting the new Sun[™] Turbo ZX workstation. Its repainting speed blows the enamel off the competition. Based on an average of the four leading MCAD workstation applications, Turbo ZX creates wireframe repaints two to three times faster than comparable mid-range workstations. Now what are you waiting for? For more information about our blazing new workstation, just contact us on the Internet at <http://www.sun.com> or call 1-800-786-0785, Ext. 295. It's toll-free.



©1995 Sun Microsystems, Inc. All rights reserved. Sun, Sun Microsystems, the Sun Logo, Turbo ZX, and The Network Is The Computer are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States and other countries.

For More Information Write In No. 567

▶ High-Voltage MOSFET Switching Circuit

This circuit is designed for use in a plasma ion-beam texturing process.

Lewis Research Center, Cleveland, Ohio

The circuit illustrated in the figure reliably switches power at a supply potential of $-1,500$ V, with controlled frequency and duty cycle. The circuit is used in argon-plasma ion-bombardment equipment for texturing copper electrodes, as described in "Texturing Copper To Reduce Secondary Emission of Electrons" (LEW-15898) elsewhere in this issue of *NASA Tech Briefs*. (This circuit is the switching module mentioned in that article.) This circuit can also be adapted to use in powering gaseous flash lamps and stroboscopes.

The circuit includes a pair of series-connected metal oxide/semiconductor field-effect transistors (MOSFETs). A pair of MOSFET-driver integrated circuits

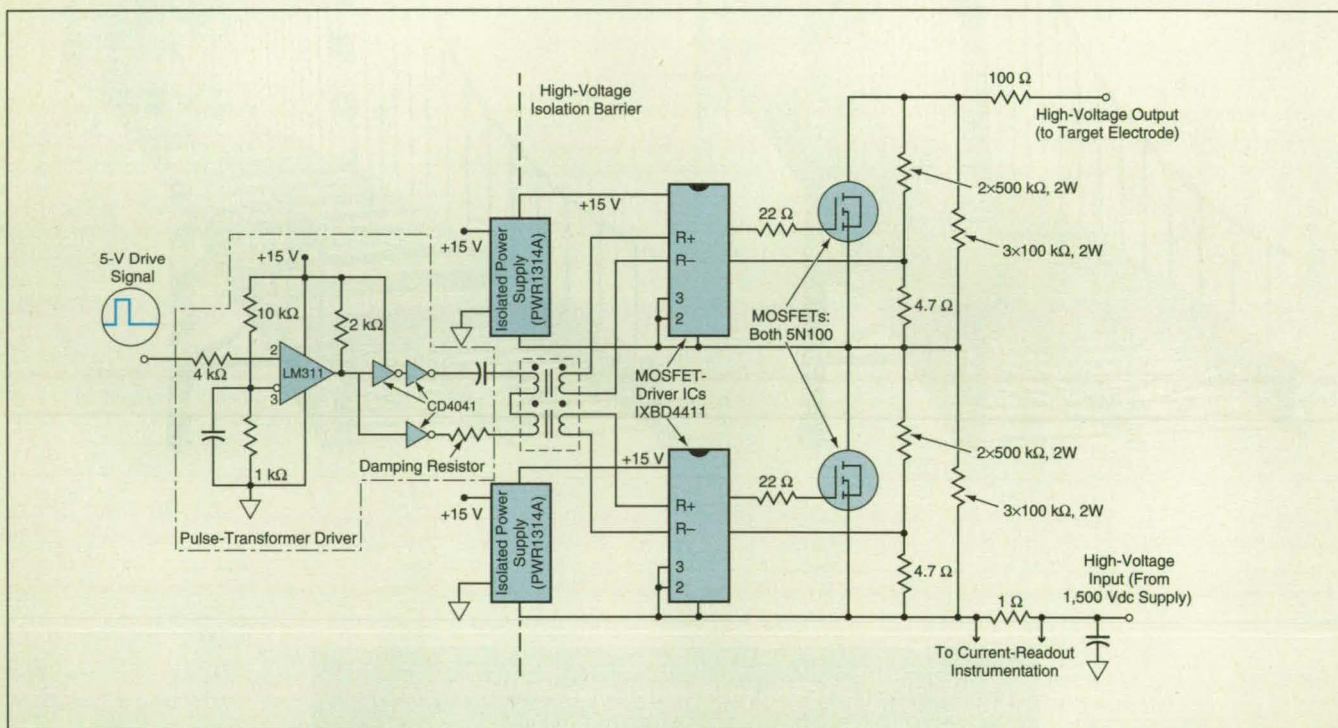
(ICs) supply identical signals of $+15$ V to turn the MOSFETs on and -5 V to turn them off. Two isolated power supplies with a $4,000$ -V insulation rating ensure isolation of the MOSFET-driver ICs.

The MOSFET-driver ICs are triggered by pulses coupled via pulse transformers. The secondary windings of the transformers are galvanically isolated from the primary windings, which are connected in series. The frequency (typically between 5 and 100 Hz) and duration (typically 20-percent duty cycle) of pulses is that of a 5 -V drive signal, which is fed to a pulse-transformer driver circuit. The output of the driver circuit, which has a peak-to-peak amplitude of 1.5 V, is fed to the $R+$ and $R-$ terminals

of the MOSFET-driver ICs.

The load current is typically 100 mA. The MOSFETs chosen for use in this circuit should have current ratings 10 times the anticipated load current: this is desirable to provide margin for arcs and surges that occur when the argon plasma is started. A $100\text{-}\Omega$ series resistor in the output lead provides added protection against overcurrent in case of arcing. The circuit has operated reliably in ion-beam texturing of more than 100 copper substrates.

This work was done by Kenneth A. Jensen of Lewis Research Center. For further information, write in 94 on the TSP Request Card. LEW-15986



The MOSFETs Are Turned On and Off under control of pulses fed to the MOSFET gates via driver circuits and a pulse transformer. A voltage-divider network of resistors across the series-connected MOSFETs provides both plasma-sustaining (keep-alive) current and voltage protection of the MOSFETs.

▶ Asymmetric Switching for a PWM H-Bridge Power Circuit

Only two of the four switches interrupt substantial current.

Lewis Research Center, Cleveland, Ohio

An asymmetric timing scheme improves the design and operation of a pulse-width-modulation (PWM) H-bridge switch-and-transformer circuit like that shown in Figure 1. The circuit could be part of a dc-to-dc converter or a dc-to-

ac inverter; in either case, the output current or voltage is regulated by adjusting the times of opening and closing of semiconductor switches 1 through 4 to adjust the durations of current pulses in the primary winding of the transformer.

The asymmetric timing scheme is derived from a symmetric phase-shift-regulator timing scheme (see Figure 2) that provides a local current loop for turn-off snubbing — that is, for dissipating the turn-off-transient current flowing in the

WHO DOESN'T USE OUR DC/DC CONVERTERS?

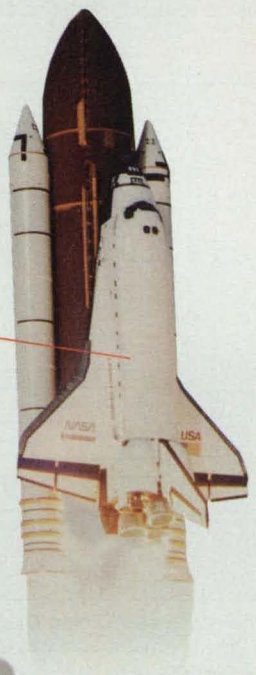
Hughes does.



McDonnell Douglas does.



Rockwell does.



Grumman does.



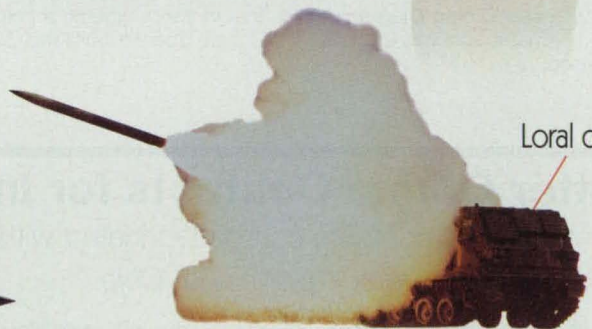
Them.



Boeing does.



Loral does.



If you ever had any doubts about which converters to spec, rest assured our customers haven't. They're some of the biggest names in defense and aerospace. And you can bet they've done their homework.

We have over 60 DC/DC products on the DESC/SMD source list. All types have been tried and tested in mission-critical applications. Our AHE 2800, AHF 2800, ATO 2800 and ATW 2800 Series devices offer single, dual and triple-channel designs, with power outputs from 5 to 120 watts. And we manufacture in an automated MIL-STD-1772 certified facility with full military screening.

For details on our models, call (408) 988-4930 or fax (408) 988-2702. And if you've got an application we don't fit, don't worry. Chances are we're working on it.

LAMBDA
Advanced Analog Inc. 

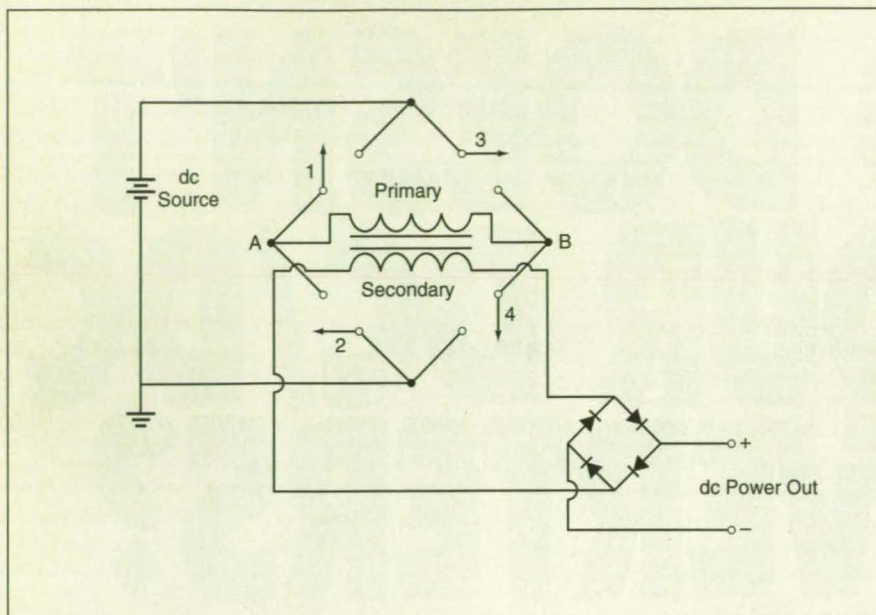


Figure 1. The **Basic H-Bridge Switch-and-Transformer** configuration is common to numerous dc-to-dc converter and dc-to-ac inverter power-supply circuits.

leakage inductance of the transformer. This current loop is a short circuit through the primary winding and switches 1 and 3. The main objective in devising the asymmetric timing scheme is to avoid the complication and cost of the high-speed floating drive circuitry that would be needed to open switches 1 and 3 while they were carrying substantial current.

For this purpose, the current-interruption function is distributed asymmetrical among the switches in such a way that switches 1 and 3 are carrying no appreciable current at their respective turn-off times. Only switches 2 and 4, which are referenced to ground and can therefore be turned on and off rapidly with simple drive circuitry, are used to interrupt appreciable current.

*This work was done by See-pok Wong of Space Power, Inc., for **Lewis Research Center**. For further information, write in 57 on the TSP Request Card. LEW-15763*

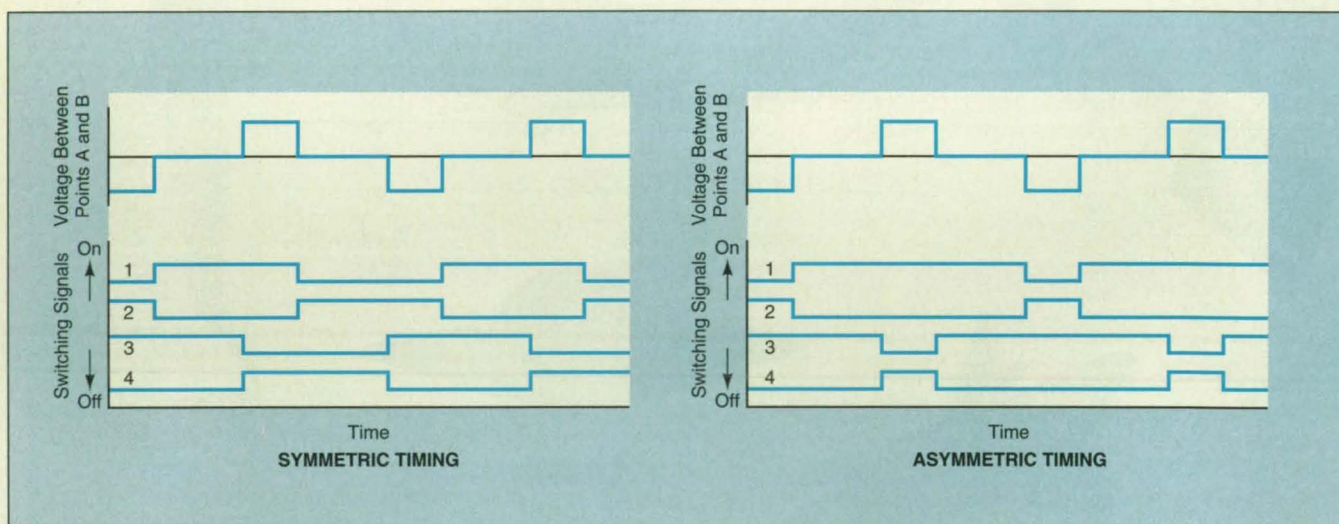


Figure 2. These **Timing Diagrams** show that in the symmetric scheme, every switch interrupts current at some time during a cycle, whereas in the asymmetric scheme, switches 1 and 3 are opened while they carry no current so that only switches 2 and 4 interrupt current when they are opened.

▶ Better Ohmic Contacts for InP Semiconductor Devices

Low-resistance contacts can be fabricated without destructive heat treatments.

Lewis Research Center, Cleveland, Ohio

Four design modifications enable fabrication of improved ohmic contacts on InP-based semiconductor devices. The improved contacts exhibit low electrical resistances and can be fabricated without exposing the devices to destructive predeposition or postdeposition treatments.

Until now, the fabrication of low-resistance contacts on InP devices has involved either the creation of disorder in

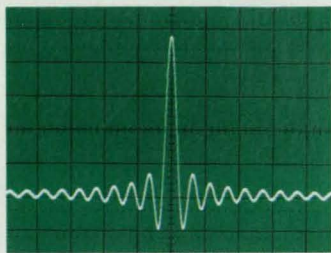
the InP crystalline lattice (e.g., by bombardment with energetic ions) before deposition, or subjecting the devices to high temperatures after deposition of the contact materials. Both of these treatments degrade the devices; they must be carefully controlled to effect tradeoffs between achieving low contact resistance and inflicting mechanical and electrical damage.

The first modification consists of the

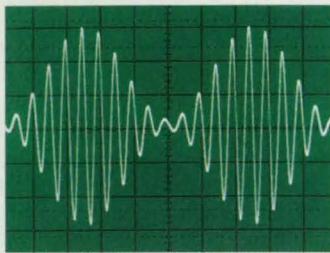
insertion of a layer of gold phosphide (Au_2P_3) between n-doped InP and a metal or other overlayer of contact material (see figure). No predeposition bombardment or postdeposition heat treatment is needed, and the resulting contact resistivity is typically of the order of $10^{-6} \Omega\text{-cm}^2$.

The second modification includes the first modification plus the use of a particular metal overlayer to achieve very

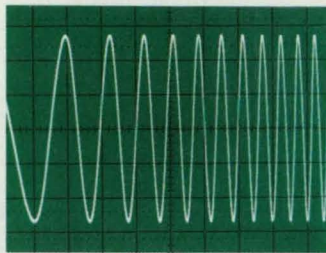
There are many areas where our function generator will surpass your expectations.



A built-in 12-bit, 40 MSample/sec, 16 k-deep arbitrary waveform generator easily handles your custom waveform needs.

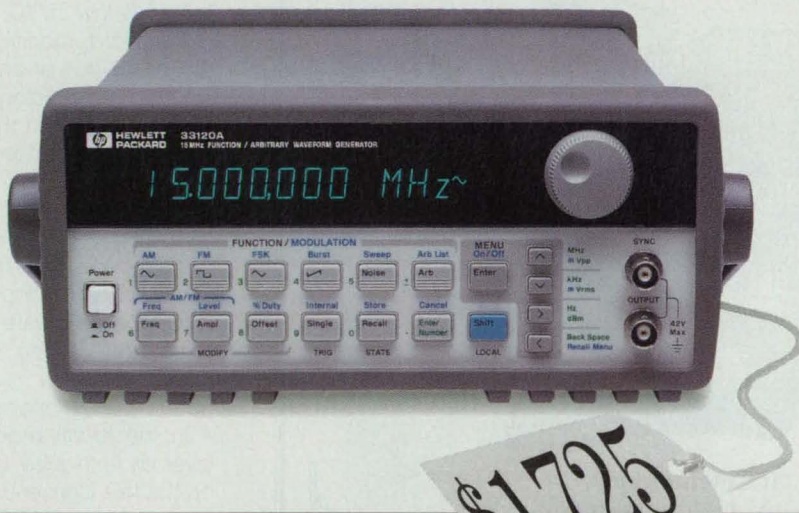


Internal AM, FM, FSK and burst modulation eliminate your need for a second modulation source.



Both linear and log sweeps are built in, making filter and amplifier testing quick and easy.

And one where it falls short.



New external phase lock option!
\$395.00
(U.S. List)

The HP 33120A 15 MHz synthesized function/arbitrary generator: Within budget, without compromise.

In the world of function generators, price and performance have always been synonymous. So it's understandable you'd expect to pay more for the measure of confidence you get with a synthesized signal source that delivers stable, accurate signals test after test. Or, for the flexibility to generate complex waveforms with arbitrary waveform capability.

You'd probably also expect to pay a premium for the convenience of built-in sweep and modulation functions. And to have both HP-IB and RS-232 interfaces standard.

But order the HP 33120A fully loaded function/arbitrary generator, and

you'll get something totally unexpected: a price you can afford.

Want to speak to someone about the HP 33120A function/arbitrary

Call HP DIRECT at 1-800-452-4844*, Ext. 8645 to talk to an HP engineer about your function generator needs. Or check out our on-line HP Basic Instruments (BI) Catalog at <http://www.hp.com/info/BI04>.

generator features, its complementary BenchLink/Arb software, or your application needs? Calling HP DIRECT is the fast, easy way to get all your questions answered — with no obligation to order.

You see, HP DIRECT is your direct line to information and solutions for HP basic test instruments. With

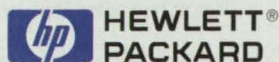
one simple call, you can get product specifications or any technical literature you need to make the right decision. Or, for one-on-one technical support, you can speak to an engineer who has

firsthand experience with HP products. And, of course, if you're ready to order, we can help you do that, too.

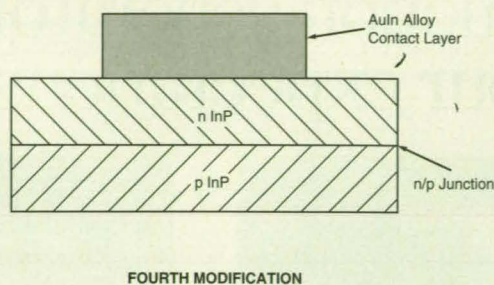
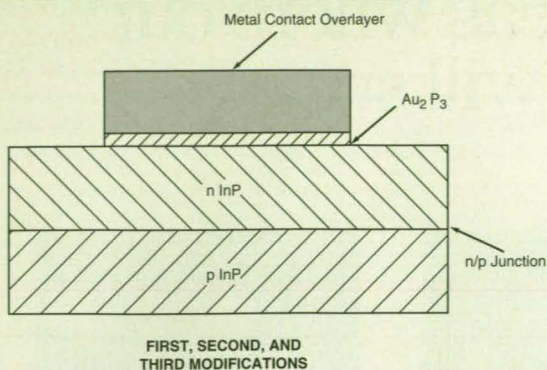
So give us a call. And discover how much more you get from HP today.

* In Canada, call 1-800-450-2271, Dept. 476

There is a better way.



© 1986 Hewlett-Packard Co. T16P00555B, UNASATB



Ohmic Contacts fabricated according to the four modifications described in the text exhibit low contact resistivities, and in some cases, slightly higher resistivities combined with thermal stability.

"The Case of Indium Intrigue"

"What has your investigation revealed, Holmes?"

"It's elementary, Watson. There's only one source for *indium* and that's Arconium."

One doesn't need to be the world's greatest sleuth to uncover the reasons why *indium* products from Arconium are the answer to many of today's disparate R&D problems.

This highly malleable, low melting point (156.7°C) metal provides numerous industries with the joining, coating, sealing, conducting, light filtering, plating and soldering solutions they've come to depend on.

Whether your application requires *indium* based alloys, chemicals, oxides or salts, Arconium has the resources to fit your unique manufacturing requirements.

Need more information? Then why not do a little detective work yourself and call us today!



Your Indium Resource

50 Sims Avenue • Providence, RI, USA 02909 • T: 800/343-0282 • 401/456-0800 • F: 401/421-2419

Witmetaal Belgium N.V. • Molenberglei, 32 • B-2627 Schelle • Belgium

Tel: 32-3-880-8745 • F: 32-3-880-8759

Alpha Metals Limited • 1/F Block A • 21 Tung Yuen Street • Yau Tong Bay • Kowloon, Hong Kong
T: 852-347-7112 • F: 852-347-5301

low contact resistivities. Specifically, it involves the deposition of an Au_2P_3 interlayer followed by an overlayer of AuGa or Auln alloy, again without destructive pre-deposition or postdeposition treatment. It has been found that, depending on the amount of Ga or In in the alloy, the contact overlayer acts synergistically with the Au_2P_3 interlayer to produce contact resistivities as low as $10^{-7} \Omega\text{-cm}^2$.

The third modification also involves the deposition of an Au_2P_3 interlayer; in addition, a refractory metal (W or Ta) is deposited to form the contact overlayer. The contacts thus formed exhibit resistivities of about 10^{-3} to $10^{-4} \Omega\text{-cm}^2$ and can be operated at temperatures of as much as 400 °C for tens of hours without degradation. This modification can be useful in fabricating devices that must withstand deliberate or inadvertent heat treatments during fabrication or that must retain low resistivities when exposed to high operating temperatures.

In the fourth modification, a contact layer of Auln alloy is deposited directly on the InP. Conventional contact materials are unable to withstand high temperatures for long times without degradation of the p/n junctions in the underlying InP devices. Depending on the relative concentrations of Au and In in this contact alloy, chemical reactions between the metal contact layer and the underlying InP at high temperatures are retarded to varying degrees. In particular, a composition of $\text{Au}_{50}\text{In}_{50}$ has been found to stop effectively all device-degrading metallurgical reactions at the alloy/InP interface at a temperature of 400 °C: contact resistivities remain of the order of $10^{-4} \Omega\text{-cm}^2$ for many hours, even at this high temperature.

This work was done by Victor G. Weizer of Lewis Research Center and Navid S. Fatemi of Sverdrup Technology, Inc. For further information, write in 3 on the TSP Request Card.
LEW-15747/497/498



COMPLEX HEATING

SPECIFICATIONS

WELCOME.

(ACCEPTING NEW APPLICATIONS ON A DAILY BASIS.)

When you're in need of a heat solution, select the supplier who can help make your product more competitive or your manufacturing process easier. Call Watlow.

Whatever the complexity of your application, Watlow can be your single source supplier for both development and integration of heaters, sensors, and controllers. We've increased heater reliability in a military satellite, reduced component size for a soldering iron used in fiber optic cable splicing and added multi-loop



intelligence in circuit board manufacturing. We'll work to meet your design considerations, too.

Get Our New Guide to Selecting the Best Source for Your Heat Solution.

Want proof? We've detailed our solutions to some of our most complex and demanding customer requirements. Call 314-878-7820, ext. 2326, or fax us at 314-878-2369 for your free copy.

 **WATLOW**



Electronic Components and Circuits

Low-Bandgap Thermovoltaic Materials and Devices

These devices would operate from cooler sources.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed class of thermovoltaic devices would be made of semiconductor materials that have relatively low energy gaps between their valence and conduction electron-energy bands ("low bandgaps" for short). These devices would exhibit relatively high energy-conversion efficiencies while receiving energy from sources that are at temperatures lower than those used with older thermovoltaic devices.

A thermovoltaic cell converts thermal energy into electricity. More specifically, it converts a favored spectral subcomponent of the radiant component of thermal energy to electricity, similarly to a photovoltaic device. The relationship between the bandgap, E_g , of the thermovoltaic material and the optimum temperature of the source of energy is straightforward: For most efficient utilization of the incident thermal radiation, E_g should closely match the energy of photons at the peak of the spectrum of the radiation. This is most important if the thermal emitter provides very narrow band output. If the output is relatively broadband, there is somewhat more flexibility in the choice of band gap. For example, the band gap of the cell may lie slightly above the energy of photons at the peak of the spectrum with only a minor reduction of cell efficiency. This would extend the acceptable band gap range slightly upward.

Most of the previous effort to develop thermovoltaic technology has concentrated on photovoltaic cells made of relatively high-bandgap materials like Si ($E_g = 1.12$ eV) or GaAs ($E_g = 1.42$ eV). To achieve adequate energy-conversion efficiencies with thermovoltaic cells made of these materials, it is necessary to use energy sources that have temperatures between 2,000 and 2,500 K. However, sources operating at such high temperatures may not always be feasible; they can evaporate and thereby cause contamination. Furthermore, thermal-management considerations may rule out the presence of such high temperatures in some thermovoltaic apparatuses.

The proposed low-bandgap thermovoltaic devices would likely be made of semiconducting compounds from periods III and V of the periodic table of elements (often called "III-V semiconductors" for short). The III-V semiconductors are favored for the development of high-efficiency cells because methods of processing these compounds into electronic devices are reasonably well established and commercialized. Some candidate binary, ternary, and quaternary

serious consideration. Both materials can be grown readily by the use of various deposition techniques. Three of the most suitable methods for depositing single crystal layers of these III-V compounds on suitable substrates are molecular beam epitaxy (MBE), metalorganic chemical vapor deposition (MOCVD), and liquid phase epitaxy (LPE). The nature of the semiconductor material and the requirements of the device structure both influence the

Material (Note 1)	Lattice Constant, a (Å)	x	y	Substrate	E_g (eV) (Note 2)
InAs	6.0584	-	-	InAs, GaSb	0.36
$Ga_{1-x}In_xAs$	Equation (1)	0.75 to 1	-	InAs, GaSb, InP	0.36 to 0.52
$Al_{1-x}In_xAs$	Equation (2)	0.93 to 1	-	InAs, GaSb	0.36 to 0.52
$InP_{1-x}As_x$		0.82 to 1	-	InAs, GaSb	0.36 to 0.52
$Ga_{1-x}In_xSb$		0.20 to 0.45	-	GaSb, InAs	0.36 to 0.52
$Al_{1-x}In_xSb$		0.81 to 0.90	-	InSb	0.36 to 0.52
$InP_{1-x}Sb_x$		0.47 to 0.65	-	GaSb, InAs	0.36 to 0.52
$Al_xGa_{1-x}In_{1-x-y}As_ySb_{1-y}$	0.00 to 0.08	0 to 0.24	-	InAs, GaSb, InP	0.36 to 0.52
$Ga_xIn_{1-x}As_ySb_{1-y}$ (Note 3)		approx. 0.1 to 0.2	approx. 0.08 to 0.18	GaSb	0.53 eV and up
GaSb (Note 4)	6.0959	-	-	GaSb, InAs	0.72
	$a = 6.0584x + 5.6533(1-x)$ (Equation 1)				
	$a = 6.0584x + 5.6611(1-x)$ (Equation 2)				
	$E_g = 0.36 + 1.425(1-x) - 0.436x(1-x)$ (Equation 3)				
	$E_g = 0.36x + 2.95(1-x) - 0.52x(1-x)$ (Equation 4)				
Note 1	There are seven other quaternaries which have band gaps in this range (0.36 eV to 0.52 eV) and could be candidates for TPV energy conversion: GaInPAs, GaInPSb, AlGaInSb, AlInPAs, AlInPSb, AlInAsSb and InPAsSb.				
Note 2	The band gap range 0.36 eV to 0.52 eV corresponds to peak photon energies for thermal emitters at temperatures of 866 K to 1255 K. For emitters which are relatively broadband, this range can be extended upward somewhat, perhaps to about 0.6 eV.				
Note 3	This quaternary enters a miscibility gap at band gaps below 0.53 eV.				
Note 4	Although its band gap is too high for use with these thermal emitters, the binary GaSb is included for purposes of comparison.				

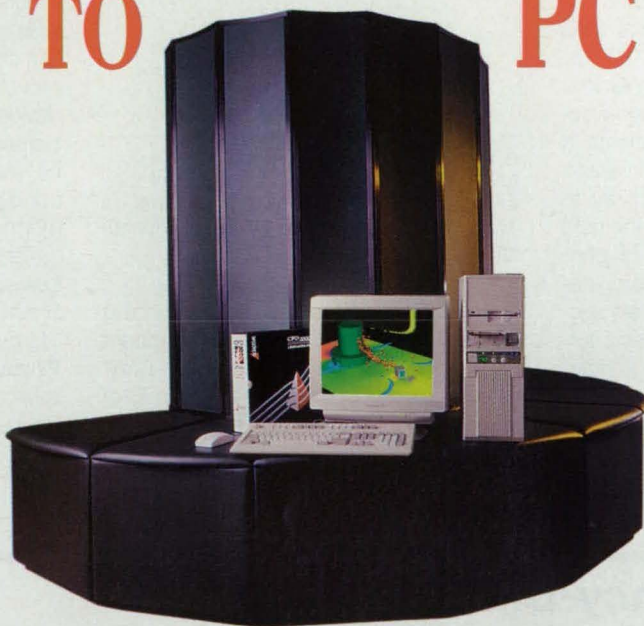
These III-V Semiconductor Compounds have bandgaps lower than those of materials used previously in thermovoltaic devices.

III-V semiconductors are listed in the table. The bandgaps of most of these compounds are matched to the energies of photons at the peaks of thermal-radiation spectra for temperatures from 866 to 1,255 K. The ternary and quaternary compounds offer more versatility (in terms of degrees of freedom of chemical composition) for such matching.

Of all of these compounds, InAs and $Ga_{1-x}In_xAs$ initially received the most

choice of deposition technique. Of these, MBE is considered to be the most straightforward technique for growing heterostructures with monolayer thickness and nearly atomically abrupt junctions. In addition, MBE enables nonuniform doping to achieve tailored novel electronic and/or optical properties. MOCVD offers a faster growth rate, often significantly faster, than MBE. MOCVD is also more readily scaleable to large

FROM SUPERCOMPUTER TO PC



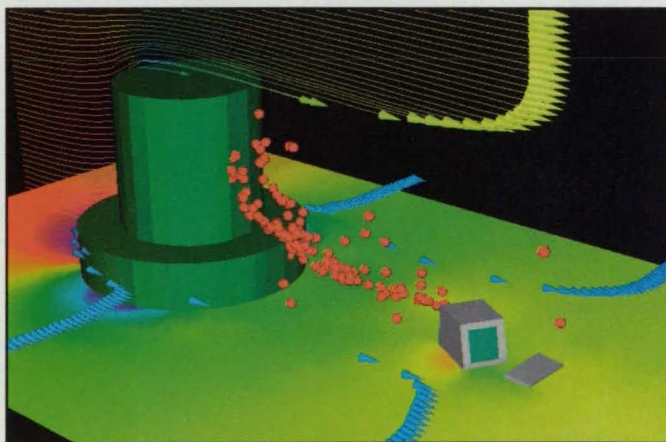
Take the power of CFD into your own hands, the way you work, where you work — at your own desk!

Adaptive's newest version of CFD2000 can meet you on almost any platform: your PC, your workstation, or your supercomputer.

Now, computer simulations of physical processes involving fluid dynamics coupled with heat transfer can be performed on your desktop. With CFD2000™, full 3D viscous Navier-Stokes flow — once achievable only via the supercomputer — is at your fingertips.

As a leader in computational fluid dynamics for over 20 years, Adaptive delivers software with advanced simulation capabilities,

CFD SOLUTIONS FLOW.



accomplished through continuous development and application. The results: CFD2000™.

Today's advances in computer memory and computer speed, in conjunction with CFD2000's™ revolutionary advances in numerical methods and user interface graphics tools, provide an enabling technology for designers and analysts who are addressing real problems in engineering mechanics.

Equip yourself with the tools that make engineering solutions flow. Call your Adaptive Technical Sales Engineer today to

find out how to solve your design challenges using computational fluid dynamics.

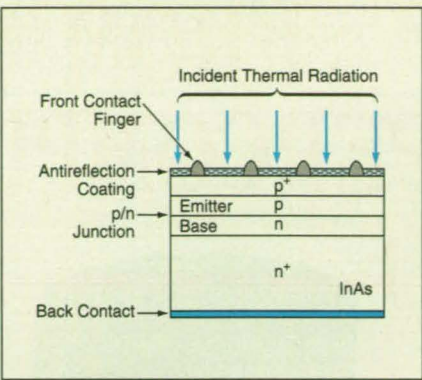


"Adapt or Die."

area deposition, and tends to produce material with very good surface morphology. LPE is the least expensive of these techniques and generally requires the least complex equipment. It permits relatively fast deposition rates and can be scaled up to large areas. It is particularly attractive for devices in which exceedingly sharp interfaces are not required.

The figure shows a conceptual InAs low-bandgap thermovoltaic cell. The p-doped layer would be used as an emitter in order to take advantage of the high electron mobility. The reflection coefficients of the front and back surfaces would typically be made 0.001 and 0.9, respectively, to ensure minimum reflection loss at the front surface and maximum recycling of photons at the back surface. The recombination velocities of the minority electric-charge carriers at the front and back surfaces are assumed to be 10 cm/s; in practice, this could be achieved by use of p⁺ and n⁺ minority-carrier mirrors.

The performance of the cell was evaluated by computer simulation, using a set of



A Thermovoltaic Cell would resemble a photovoltaic cell, but it would be made of low-bandgap semiconductor material to maximize energy-conversion efficiency at appropriate infrared wavelengths.

representative dimensions and doping parameters, assuming that the incident black-body radiation was filtered to eliminate photons of energy less than the E_g of InAs (eliminating wavelengths greater than 3.4 μm), and assuming that the cell was maintained at a temperature of 25 °C. The

energy-conversion efficiency of the cell was found to increase sharply, as a function of the factor of concentration of the radiation, from an efficiency 12.8 percent at 1 \times (natural) concentration to an efficiency 22.8 percent at 32 \times concentration, then to decrease gradually after reaching a peak of 23.2 percent near 64 \times concentration. It is noteworthy that the computed efficiency is as high as it is at a concentration of 1 \times : this characteristic is as desirable in a thermovoltaic device as it is in a photovoltaic device, because high optical concentration increases cost. Optical concentration may be feasible for certain, although not all, configurations and geometries of the thermal emitter and TPV cells.

This work was by Tiong Ong, Carol Lewis, and Dale Burger of Caltech and Brian Campbell and Paul Baldasaro of Martin Marietta Corp. for NASA's Jet Propulsion Laboratory. For further information, write in 89 on the TSP Request Card. NPO-19085

Digital Frequency-Differencing Circuit

This circuit measures both the sign and the magnitude of the difference in frequency.

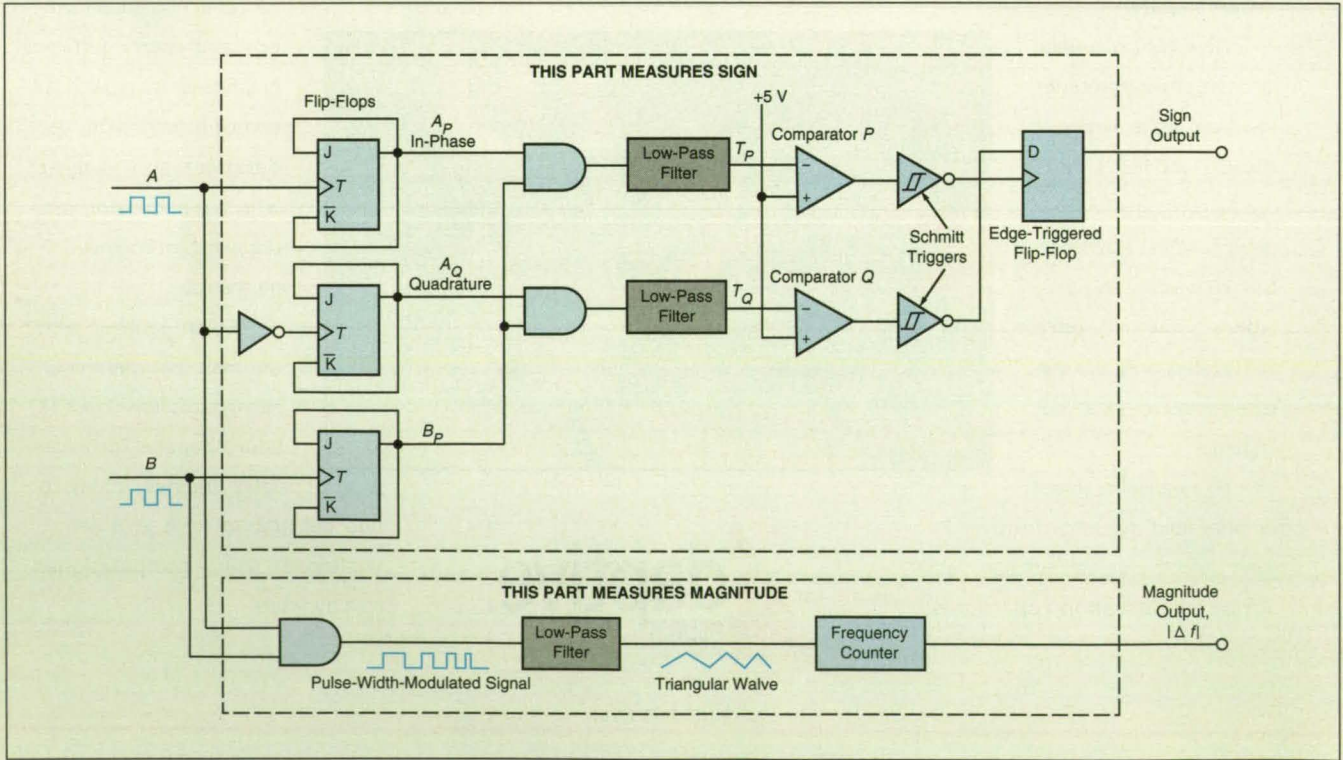
Langley Research Center, Hampton, Virginia

The circuit shown in the figure measures the difference between the frequencies of two square-wave clock signals, A and B ($\Delta f = f_A - f_B$, where f_A and

f_B are the two frequencies). One part of the circuit measures $|\Delta f|$ — the magnitude of the difference — provided that Δf is less than half of either f_A or f_B , which-

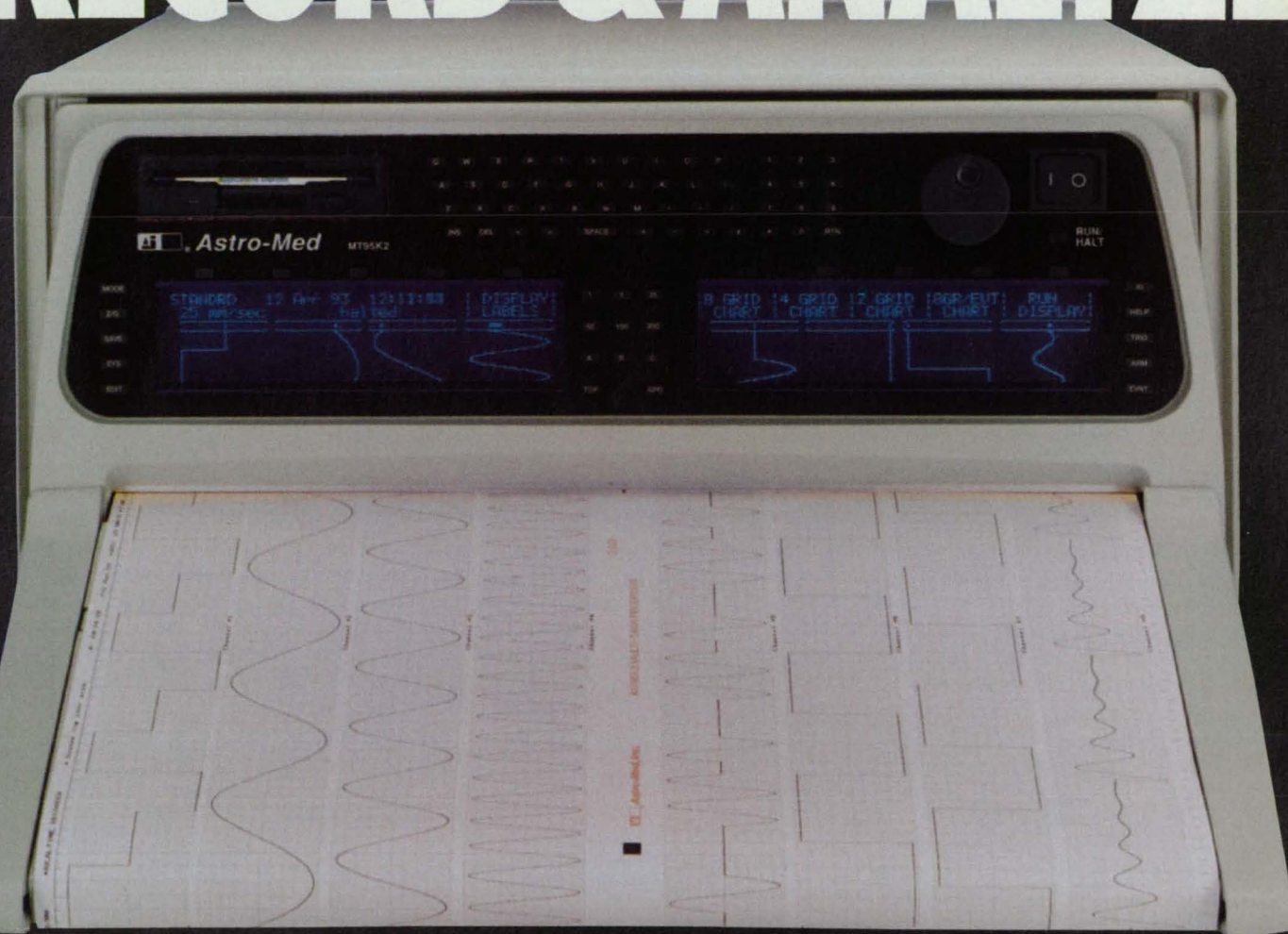
ever is lower. The other part of the circuit measures the sign of Δf .

In the part of the circuit that measures $|\Delta f|$, clock signals A and B are first mul-



This Circuit Measures $f_A - f_B$, provided that $|\Delta f|$ is less than the smaller of $f_A/2$ or $f_B/2$.

MONITOR, RECORD & ANALYZE



- No Delay . . . see full traces on monitor while recording
- On-Board Data Analysis as well as by host program
- Patented Twin Printhead Design . . . 300 dpi laser printer resolution for clear, crisp traces
- On-Board Signal Conditioning for voltage, temperature, pressure and strain recording
- Front Panel Floppy Drive for personal chart and system setups
- Data Capture . . . store up to 32 megabytes in RAM; 170 megabytes to internal hard drive; stream to external 2 gigabyte drive via SCSI; archive to DAT or floppy drive
- 8 to 32 Waveform Channels . . . plus 32 events; DC to 20 kHz; chart speeds to 500 mm/sec
- Record analog, digital, or both

The MT95K2 lets you preview your data, record it, store it, play it back, analyze it, record it again, and more! For a basic 8 channel recorder or a sophisticated 32 channel recording system, the MT95K2 is the perfect platform for you today and tomorrow!

Phone, fax, or write for details.



Astro-Med, Inc.

Astro-Med Industrial Park, West Warwick, Rhode Island 02893
Phone: (401) 828-4000, Toll Free: (800) 343-4039, Fax: (401) 822-2430
In Canada Call: 1-800-565-2216

Sales and Service Centers throughout the U.S., Canada and Europe • Dealers located throughout the world.

Astro-Med is System Certified to ISO 9001

For More Information Write In No. 531

tiplied in a two-input AND gate. The output of the AND gate is a pulse-width-modulated signal in which the duration of the pulses oscillates at a frequency of Δf . This signal is low-pass filtered to obtain a triangular waveform of frequency Δf . A counter measures this frequency.

In the part of the circuit that measures the sign of Δf , clock signal A is first divided, by two flip-flops, into a half-frequency in-phase clock signal A_P and a half-frequency quadrature clock signal A_Q . A third flip-flop divides clock signal B into a half-frequency in-phase clock signal, B_P . A_P and B_P are multiplied in a two-input AND gate and low-pass filtered to produce in-phase triangular wave T_P at frequency Δf . A_Q and B_P are processed similarly to obtain quadrature triangular wave T_Q at frequency Δf .

The sign of Δf can be determined from the phase relationship between T_P and T_Q . If $f_A > f_B$, then T_Q attains its maximum amplitude when T_P is halfway between its minimum and maximum amplitude and is increasing; if $f_A < f_B$, then T_Q attains its minimum amplitude when T_P is halfway between its minimum and maximum amplitude and is increasing.

The remainder of the circuit detects these conditions. The analog comparators detect the half-amplitude-interval levels of both signals. The outputs of the comparators are conditioned by Schmitt triggers and clamped to transistor/transistor-logic voltage levels. Finally, the state of an edge-triggered flip-flop indicates the sign of Δf as follows: Its output is switched to the output level of comparator Q on the low-to-high transition of

comparator P . Thus, its output is high if $f_A > f_B$ and low if $f_A < f_B$.

To prevent the state of the edge-triggered flip-flop from changing spuriously during high-to-low transitions of the comparators while T_P is increasing, it is necessary to prevent oscillations in the outputs of the comparators. Such oscillations are prevented by providing 1 percent hysteresis in the comparators and by use of a sharp-cutoff low-pass filter, which limits the amplitudes of the clock-frequency components to within the hysteresis band. If Δf is close to $f_A/2$ or $f_B/2$, then a filter of high order is needed.

This work was done by John S. Tripp of Langley Research Center. For further information, write in 110 on the TSP Request Card. LAR-14951

Imaging Magnetometer

Images would be formed by magnetic deflection of an electron beam.

NASA's Jet Propulsion Laboratory, Pasadena, California

An imaging magnetometer has been proposed for scientific, industrial, or military use in detecting underground structures that contain magnetic materials (principally, steel) and underground machines that generate and/or alter magnetic fields. The imaging magnetometer would include an electron-beam tube integrated with a phosphor-coated charge-coupled device (CCD). The electron-beam tube would be covered with magnetic shielding material along part of its length, leaving part unshielded at the electron-gun end (see figure).

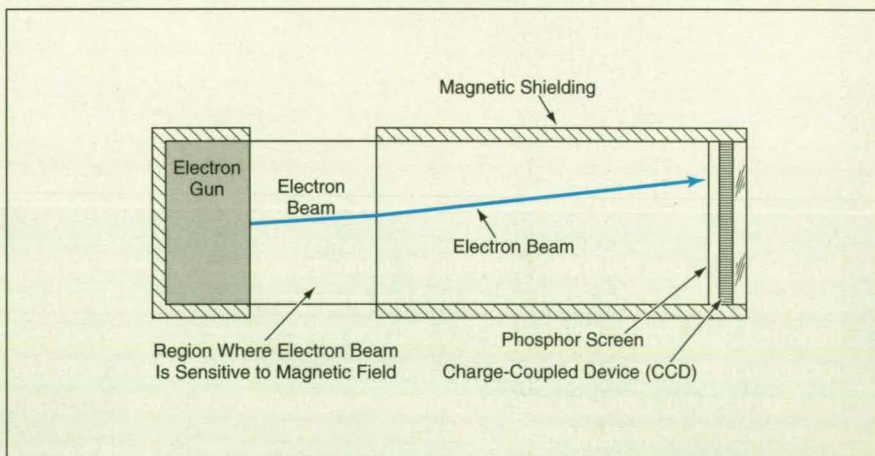
The electron gun would generate a very fine electron beam, and the beam would be aimed at the phosphor and scanned across the phosphor in a raster or other suitable pattern, as in an ordinary cathode-ray tube. The electron beam in the unshielded portion would be deflected by a perpendicular magnetic field. The resulting distortion of the raster or other scan pattern would be a measure of the magnetic field. Given that typical state-of-the-art CCD pixels are only about 10 μm wide, very small beam displacements could be resolved and thus correspondingly weak magnetic fields could be detected.

A conceptual design of a prototype field model of the imaging spectrometer calls for overall dimensions of about 1.5 \times 1.5 \times 18 ft (about 0.46 \times 0.46 \times 5.5 m), an electron-beam tube with an unshielded length of 16 ft. (4.9 m), and a CCD of 1,024 \times 1,024 10- μm -square pixels. This prototype should be able to mea-

sure a magnetic field smaller than 0.1 nT (smaller than 1/500,000 \times the natural magnetic field of the Earth).

Of course, the image produced by the imaging magnetometer would not look like the magnetic object that gave rise to it. Instead, the image would be a transformed image of the magnetic field as generated or altered by the object (e.g., the magnetic field of the Earth as per-

suitable inversion algorithms, the image data acquired during the flight would be post-processed in correlation with the position data to synthesize a picture of the magnetic field. The locations, magnitudes, and directions of identifiable features of the magnetic field would then be examined to extract data on the locations, sizes, and types of magnetically detected objects.



Deflection of an Electron Beam in a long tube would be measured by use of a CCD. The deflection would provide a sensitive indication of the magnetic field perpendicular to the beam.

turbed by the object). In a typical application, the imaging magnetometer would be carried aboard an aircraft flying in a scan pattern over the terrain suspected to contain buried structures or machinery. The CCD readout would be synchronized with the position of the aircraft along its trajectory. Then by use of

This work was done by Philip I. Moynihan and Stanley L. Soll of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 90 on the TSP Request Card. NPO-19268

42 GB At 12 MB Per Second.



**50 Times the Capacity
of 3490 Tapes**

**168 Times the Capacity
of 3480 Tapes**

**250 Times the Capacity
of 9-Track Tapes**

The CY-9000 1/2" digital tape drive gives you fifty times the capacity and four times the speed of 3490 drives—with a much lower cost per megabyte. Writing data at 12 MB per second, it can store 42 GB in less than an hour. With a 32 MB data buffer, it's the perfect match for the fastest host computer systems running the most demanding storage and data collection applications.

Based on field-proven helical scan recording, the CY-9000 brings capacity and speed together like no other

True Compatibility With:

Alliant	HP	Prime
Altos	IBM	Pyramid
Apollo	ICL	Sequent
Arix	Intergraph	Silicon Graphics
AT&T	Macintosh	STC
Basic-4	McDonnell	Sun
Concurrent	Douglas	Texas Instruments
Convergent	Motorola	Unisys
Convex	NCR	Ultimate
Cray	Parallel Port	Wang
Data General	PC	— and more
DEC	Pertec	
Gould/Encore	Plexus	

solution. With a MTBF of 200,000 hours and a bit error specification of less than one in 10^{17} bits read, reliability and data integrity are also unsurpassed.

The CY-9000 can read and write both 42 GB and 12 GB cartridges, and automatically adjusts for the cartridge in use. A backlit display provides complete status information.

Backed by a one year warranty and the service and technical support of our in-house engineering teams, the CY-9000 is the high speed data storage solution you've been waiting for.

Call today for more information at
(804) 833-9000

CYBERNETICS

Tera One • Yorktown, VA 23693 • Fax (804) 833-9300

For More Information Write In No. 603



Computer-Assisted Monitoring of a Complex System

This system assists in evaluation of masses of data.

John F. Kennedy Space Center, Florida

The Propulsion System Advisor (PSA) is a computer-based system that assists engineers and technicians in analyzing masses of sensory data indicative of operating conditions of the space shuttle propulsion system during pre-launch and launch activities. An important feature of the PSA is that it is designed solely for monitoring; it does not perform any control functions. Therefore, it is not subject to the stringent design requirements (e.g., safety interlocks and redundancy) that govern the design of control systems and, as a result, can be optimized and upgraded more easily. Although the PSA was developed for a highly specialized application, it could serve as a prototype of noncontrolling, computer-based subsystems for monitoring other complex systems like electric-power-distribution networks and factories.

The PSA receives data from instrumentation and images from black-and-white, color, and infrared television cameras. It both displays these images and data in real time and records them: Thus the PSA can be used flexibly, to (a) monitor routine operation, (b) analyze trends in the data and identify incipient anomalies in those trends, (c)

diagnose anomalies, hopefully in time to decide on appropriate responses, and (d) perform historical analyses of causes and effects.

With the help of stored rules and equations, the PSA evaluates instrumentation readings to estimate operating conditions and trends in operating conditions in the affected equipment. For example, the PSA can estimate the time when a given pressure, temperature, or other parameter will exceed a limit. To obtain such an estimate, the user instructs the PSA to plot the parameter in question, selects the applicable curve-fitting option in the PSA software, specifies the limiting value, and drags a cursor of the PSA display screen over the plotted data in question. The PSA then extrapolates the plot into the future and calculates the time remaining until the extrapolated plot will reach the limit. The calculation is refined as new data arrive.

The PSA monitors the times of discrete events like openings and closings of valves. It maintains files on these times for use in analyzing trends in performance.

Plots of historical data can be overlaid on real-time plots for comparison.

Color is used to assist in distinguishing plots on the same display screen. Plots can be printed in color for presentation and/or for use in near-real-time analysis. Split graphs can be constructed to facilitate comparison of rapidly changing data. Small plots can be enlarged to full screen size for maximum resolution. Labels can be attached to lines on plots to facilitate identification. A mark can be set on a graph, such that the PSA computes the time between the mark and the time represented by the position of the cursor: this feature is valuable for determining the rate of change of a parameter with respect to time near a significant event, or when comparing historical data.

This work was done by Bob J. Beil of Kennedy Space Center; Eric M. Mickelson and John M. Sterritt of Lockheed Space Operations; and Rob W. Costantino, Bob C. Houvener, and Mike A. Super of Lockheed Sanders, Inc. For further information, write in 74 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center (407) 867-3017. Refer to KSC-11673.

Buffered Telemetry Demodulator

Signals would be processed, recorded, and reprocessed.

NASA's Jet Propulsion Laboratory, Pasadena, California

The buffered telemetry demodulator (BTD) is a radio receiver designed mainly for recovery of low-rate data binary phase-modulated onto a square-wave subcarrier on a sinusoidal or suppressed sinusoidal carrier signal and received at a low symbol-to-noise ratio. In the BTD, the received signal would not only be processed in real time but would also be recorded and subsequently reprocessed to recover data that might otherwise be lost.

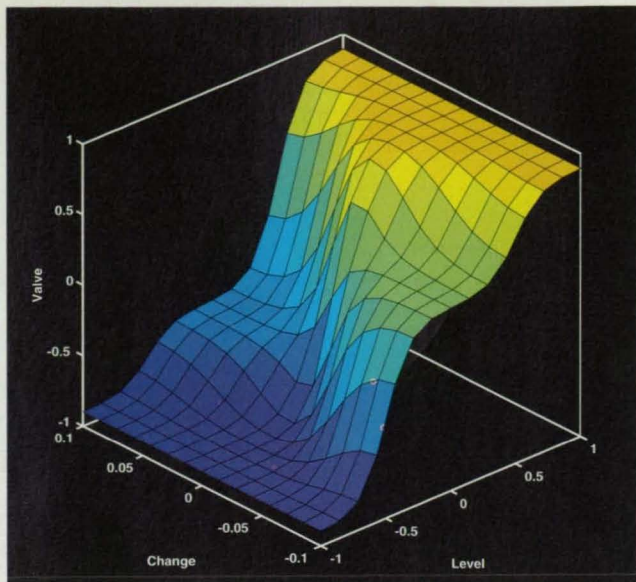
Older receivers designed for the same purpose process received signals in real

time (only); they do not buffer or store the signals for reprocessing. In some cases, signal-to-noise ratios can be so low that these receivers take long times to acquire (that is, initially lock onto or synchronize themselves with) the signals and long times to reacquire the signals when they have lost synchronization. Significant loss of data occurs during these long times out of synchronization.

Once a signal has been acquired, the BTD could process signal information recorded prior to acquisition, using esti-

mates of the present state of the signal (such as phase, frequency, and Doppler rate) to recover those data symbols lost prior to acquisition: this use of information on the present state to estimate symbols received in the past is called "smoothing." The reprocessing of information on signals received in the past can effectively accelerate acquisition.

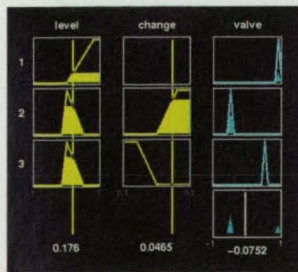
The BTD could be implemented on a general-purpose computer workstation. To reduce the computational requirement, the main processing would take



This surface shows the response of a fuzzy controller for a distillation column intake valve. The system was implemented with three simple rules using the MATLAB Fuzzy Logic Toolbox.

MATLAB® Fuzzy Logic Toolbox, the clear path to sharper solutions.

The MATLAB Fuzzy Logic Toolbox is the first product that lets you rapidly learn, evaluate, and integrate fuzzy logic into real world engineering solutions.



The exclusive Fuzzy Inference Diagram lets you interactively explore fuzzy rules and rapidly analyze system behavior.

Fuzzy logic in a complete engineering environment

The Fuzzy Logic Toolbox is the heart of a complete environment for fuzzy system design, dynamic simulation, and implementation.

Unlike fuzzy-only packages, the Toolbox lets you apply the power of fuzzy logic to your everyday engineering work—whether you're exploring new ideas, simulating alternative designs, or generating real-time code.

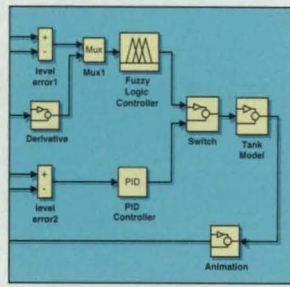
Clearly intuitive GUI

The Fuzzy Logic Toolbox's simple point-and-click user interface guides you effortlessly through the steps of fuzzy design, from setup to diagnosis. The interactive graphics let you instantly visualize and fine tune system behavior.

Focused power and flexibility

With the Fuzzy Logic Toolbox, you get built-in support for the latest methods such as fuzzy clustering and adaptive neuro-fuzzy learning. Using the high-level MATLAB language, you can easily modify any Toolbox function, and add your own.

You can even combine fuzzy logic with other MATLAB Toolboxes to create custom solutions for your applications.



SIMULINK's dynamic simulation tools simplify the design and development of real-time fuzzy systems.

Integrated simulation and code generation with SIMULINK®

The Toolbox is the only fuzzy software that is integrated with a full-function dynamic simulation system. SIMULINK lets you easily simulate fuzzy designs, compare their performance to conventional control or signal processing methods, and generate C code for embedded processors—all within a single interactive environment.

MATLAB

Picture the Power

NEW Fuzzy Logic Toolbox

- Comprehensive fuzzy design tools
- Innovative GUI for design, analysis, and debugging
- Advanced methods for adaptive systems and pattern recognition
 - Fuzzy clustering
 - Neuro-fuzzy learning
 - Sugeno fuzzy inferencing
- Integrated with SIMULINK and MATLAB Toolboxes, such as:
 - Control design
 - Signal and image processing
 - Neural networks
- Code generation for standalone and embedded real-time systems

The Ultimate Technical Computing Environment™

MATLAB is an extensible, interactive Technical Computing Environment that seamlessly integrates computation, visualization, and modeling on PCs and workstations. Now, it's the ideal way to bring the power of fuzzy logic into focus.

Call today and ask for your free fuzzy logic information package.

508-653-1415

The
**MATH
WORKS**
Inc.

24 Prime Park Way / Natick, MA 01760
Tel: 508/653-1415 Fax: 508/653-6284
E-mail: info@mathworks.com
Web: <http://www.mathworks.com>

The MathWorks is represented in the following countries:
Australia: +61-2-922-6311 • Brazil: +55-11-816-3144
France: +33-1-45-34-23-91 • Germany: +49-241-26041
India: +91-80-2-260-260 • Israel: +972-3-561-5151
Italy: +39-11-24-85-332 • Japan: +81-3-5978-5410
Korea: +82-2-517-1257 • Portugal: +34-3-415-49-04
Scandinavia: +46-8-15-30-22 • Spain: +34-3-415-49-04
Switzerland: +41-31-998-44-11 • Taiwan: +886-2-501-8787
For Belgium, Luxembourg, The Netherlands, United Kingdom and Republic of Ireland call Cambridge Control, Ltd: +44-1223-423-200 or Rapid Data, Ltd: +44-1903-821-266

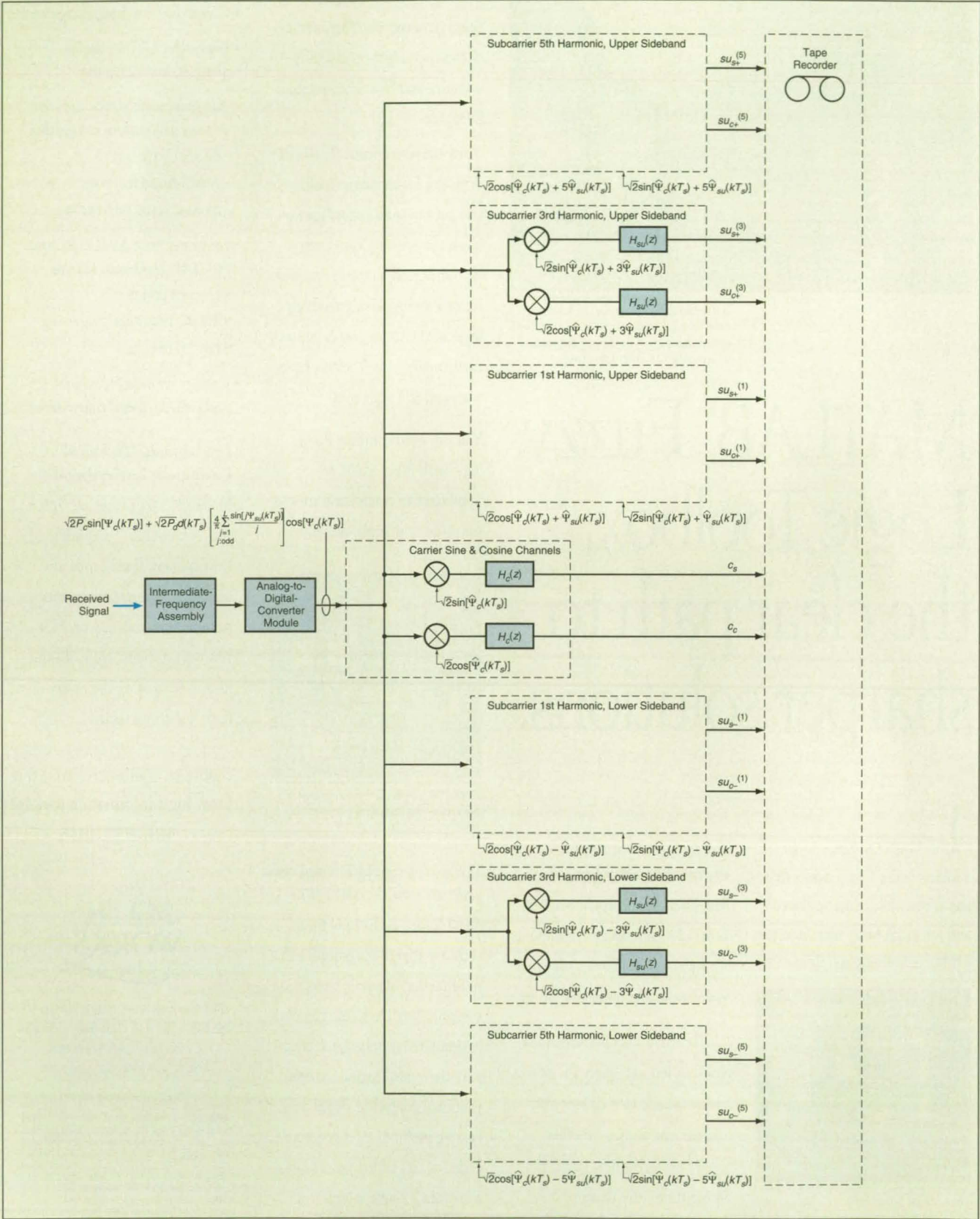
MATLAB and SIMULINK are registered trademarks of The MathWorks, Inc.

place after the incoming signal had been both open-loop down-converted to baseband and recorded on a subcarrier-harmonic basis (see figure): This feature would render the BTD independent of

the subcarrier frequency and result in a computational throughput requirement based on the data rate rather than on the bandwidth of the transmitted signal.

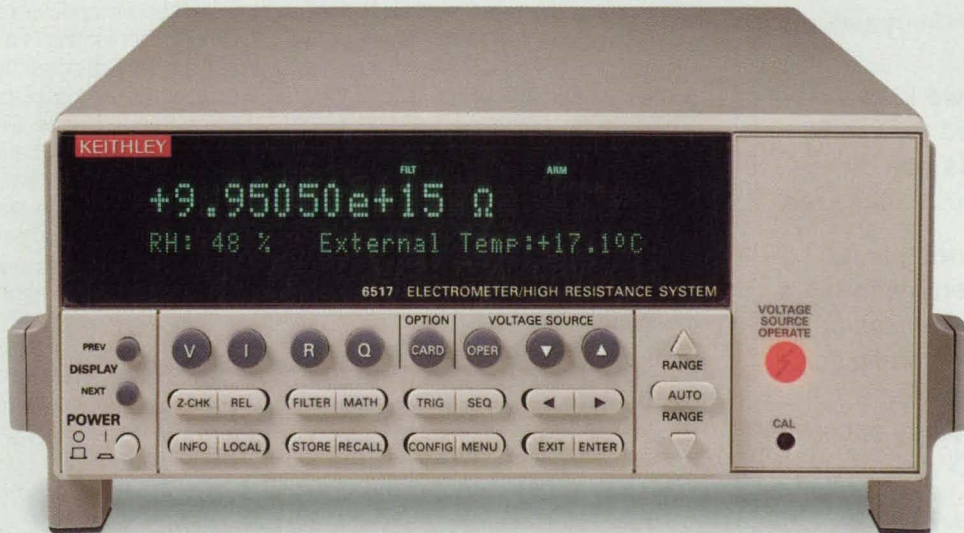
This work was done by Haiping Tsou,

Sami M. Hinedi, Biren Shah, and Robert Lee of Caltech for **NASA's Jet Propulsion Laboratory**. For further information, **write in 31** on the TSP Request Card. NPO-19080



Signals Would Be Down-Converted to Baseband and recorded on a subcarrier-harmonic basis. This scheme is one of two proposed alternative schemes for down-conversion and recording in the BTD.

" Ω Improvement"



Introducing the world's best high resistance meter. The Keithley Model 6517.

It's your most accurate solution for high resistance measurements, with 0.01% accuracy Ω The quickest, measuring $10^{12}\Omega$ with 65ms settling time for up to 125 rdgs/s Ω The easiest to use Ω Built-in programs let you test components or materials and measure resistivity or insulation resistance Ω An internal source can sweep voltages up to 1kV Ω Plus, it records time stamp, temperature and relative humidity with every measurement Ω And, since it's also an electrometer, it can measure very low currents and small charges Ω

For a demonstration, call
1-800-552-1115 Ω For specifications by FAX,
call Spec Direct™ anytime at 1-800-936-3300 and
request document #1703 Ω

KEITHLEY

"The laboratory contacts given to us by the NTTC's technology access agent helped to create a new product that should double our sales. . . saved us \$100,000 in research costs and cut time-to-market by almost a year."

—Paul Fischione

E. A. Fischione Instruments, Inc.

Access to the world of federally funded research and expertise is now available to you. . . for **Free**.

Whether your need is for your own research efforts, a manufacturing process or a new technology, the National Technology Transfer Center's technology access agents will help you.

You will receive:

- Personalized service by an experienced staff
- Prompt turnaround of your request
- The best contacts in the federal research network, giving you the expertise, facilities or technology you need

Call
800-678-6882
today!



National Technology Transfer Center
Wheeling Jesuit College
316 Washington Avenue
Wheeling, WV 26003
Fax: 304-243-2539

Compact Multifunction Inspection Head

This head contains a contact (force-and-torque) sensor and several noncontact sensors.

NASA's Jet Propulsion Laboratory, Pasadena, California

The apparatus illustrated schematically in the figure is a multiple-sensor inspection head. It is designed to be mounted at the tip of a robot arm for performing multiple automated and/or remotely controlled inspection functions. The mass of the head is about 3.5 kg.

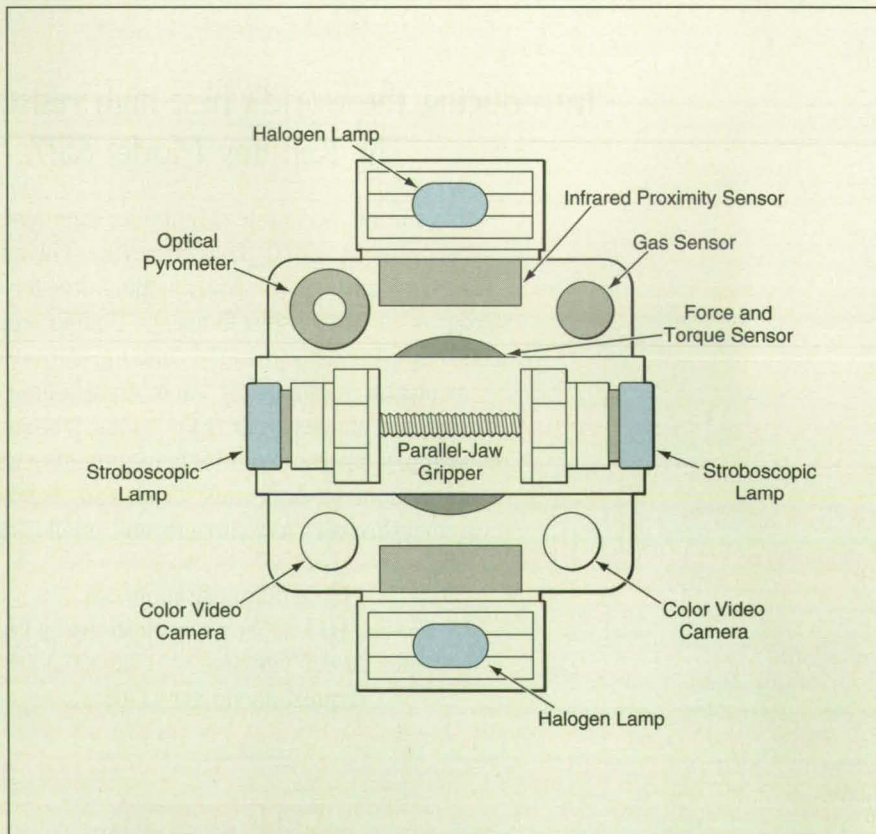
The inspection head contains two infrared sensors that measure distances up to about 75 cm by triangulation. These sensors can be used to follow and measure surface contours and to prevent collisions as the robot arm moves the head. Along with the proximity sensors, a force-and-torque sensor with 6 degrees of freedom provides readouts that aid in the control of the robot arm.

An infrared pyrometer in the head is sensitive at wavelengths from 8 to 12 μm ; it is used to measure temperatures from 0 to 1,000 $^{\circ}\text{F}$ (-18 to 538 $^{\circ}\text{C}$). Chemical vapors and other gases are sensed by a metal oxide/semiconductor

sensor, the electrical resistance of which changes when it absorbs the gases.

Two color charge-coupled-device video cameras are mounted on the head. Two halogen lamps in the head provide illumination, with intensity controlled by an optical-transistor feedback circuit. This lighting is augmented by two fast-pulse stroboscopic lamps that enable the taking of pictures in single-video-frame bursts (like those of film cameras). The cameras are calibrated for stereoscopic viewing. Because the stroboscopic lamps are mounted on the movable jaws of a parallel-jaw gripper, the angles of flash illumination can be adjusted by movement of the jaws.

This work was done by Richard A. Volpe, Robert Ivlev, and Timothy Ohm of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 15 on the TSP Request Card. NPO-19368



The **Multifunction Inspection Head** houses optoelectronic sensors, an electrochemical sensor, sources of illumination, and a parallel-jaw gripper.

Count it! Measure it! Stat it! Fit it! Plot it! We've got it!

WINDOWS 95
COMPATIBLE
32 BIT VERSION



Introducing the latest generation of the Jandel software family

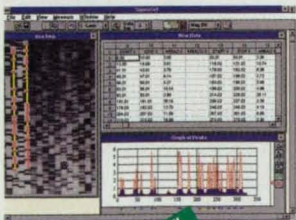
Jandel Scientific Software announces a new generation of our product family—including many fast new 32-bit versions for Windows 95 and NT. Now, with OLE 2, you can use an Excel spreadsheet inside SigmaPlot and SigmaStat—or you can directly edit an embedded graph within Microsoft Word. Jandel Scientific—the leading family of scientific and engineering software since 1982.



SigmaPlot FLEXIBLE SCIENTIFIC GRAPHING

From nonlinear regressions to multiple axes per graph, more than 75,000 researchers depend on award-winning SigmaPlot's flexibility and power to analyze and graph their technical data the way they need to.

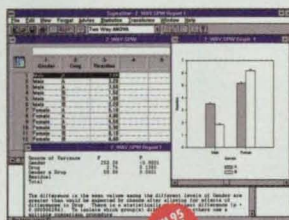
Mac 625 Win 626



SigmaGel GEL ANALYSIS SOFTWARE

Gel analysis—spot, lane, molecular weight, and DNA—on your lab or office PC. Works with inexpensive hand or desktop TWAIN-compatible scanners and imaging devices. Quality and speed previously available only in higher priced systems.

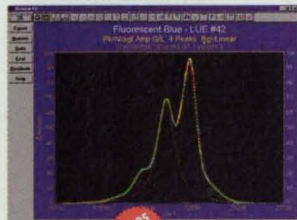
Write In No. 630



SigmaStat ADVISORY STATISTICAL SOFTWARE

Advises on the test to use, checks for violations in underlying assumptions, runs the test, and explains the results. Handles messy data. Like having a professional statistical consultant at your fingertips.

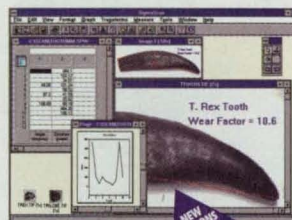
Write In No. 627



PeakFit AUTOMATED NONLINEAR PEAK SEPARATION AND ANALYSIS

Automatically smooths, finds, separates, fits, and analyzes Spectroscopic, Chromatographic, and Electrophoretic peaks. 91 built-in equations. Up to 15 UDFs. Advanced baseline subtraction and much more...

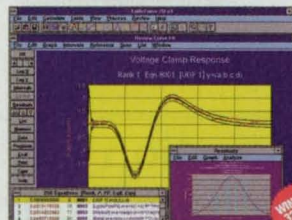
Write In No. 631



SigmaScan IMAGE MEASUREMENT SigmaScan Pro IMAGE ANALYSIS

Easy, accurate and low-cost. SigmaScan for manual image measurements or SigmaScan Pro for automated measurements, counting, and image analysis.

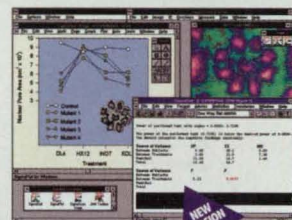
Write In No. 628



TableCurve 2D & 3D AUTOMATED EQUATION DISCOVERY AND FITTING FOR EMPIRICAL DATA

2D fits 3,456 equations (XY) 3D fits 453,697,365 (XYZ) They statistically rank each fit and allow the user to pick the best one, including up to 15 UDFs. All in seconds!

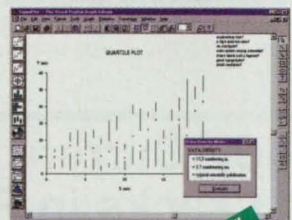
Write In No. 632



SigmaSuite INTEGRATED GRAPHING, STATISTICS & IMAGE MEASUREMENT

The power of SigmaPlot, SigmaStat, and SigmaScan at a Suite price! Measure images, run statistics, and create graphs using SigmaLink for seamless data sharing in all three products.

Write In No. 629



Visual Display Graph Library

Dr. Edward Tufte designed The Visual Display Graph Library using the unique flexibility of new SigmaPlot. This new graph library includes: *The Visual Display of Quantitative Information* book, data density meter, style guidelines, fonts, and templates.

Write In No. 633

TO GET IT CALL 1-800-4-JANDEL (1-800-452-6335)

FOR MORE INFORMATION PLEASE CALL, FAX OR E-MAIL:

Jandel Scientific: 2591 Kerner Blvd., San Rafael, CA 94901
415-453-6700 Fax 415-453-7769 Internet: sales@jandel.com
In Europe: Jandel Scientific, Schimmelbuschstrasse 25, 40699
Erkrath, Germany 02104/9540 02104/95410 (FAX).

International Dealers: Australia 2 958 2688, Brazil 11 453 5588,
Canada 519 767 1061, Chile 56 2 635 2422, Hong Kong 852 739 2001,
India 40 31 3368, Israel 972 349 0823, Japan 3 3590 2311, 3 5689 8000,
Korea 822 886 3983, Kuwait 965 242 1851, Malaysia 603 777 2597,
Mexico 525 513 0399, South Africa, 12 660 2884, Taiwan 2 788 6777,
2 705 1590 All company and/or product names are trademarks of their
respective companies. ©1995 Jandel Corporation.

Jandel
SCIENTIFIC SOFTWARE



Optical Detection of Fractures in Ceramic Diaphragms

A fracture causes reflection of a laser beam into multiple speckled spots.

NASA's Jet Propulsion Laboratory, Pasadena, California

A simple optical technique enables quick, nondestructive inspection of surfaces of ceramic diaphragms and disks for fractures and discontinuities. The technique involves reflecting a beam of light from a laser at a glancing angle of about 20° to 25° off the surface to be inspected and examining the pattern of reflected light on a suitable viewing surface as the

beam is swept across the surface (see Figure 1). When a fracture is present, the reflection pattern separates into two or more speckled spots (see Figure 2).

The technique has been applied in the inspection of ceramic diaphragms bearing electronic circuits. Detection of fractures is especially important where the circuits carry high voltages because frac-

tures can cause high-voltage breakdown with failure of associated equipment. The technique may also be useful in detection of fatigue cracks on aircraft (but has not yet been tested in this application).

This work was done by Eric G. Laue of Caltech for NASA's Jet Propulsion Laboratory. No further documentation is available. NPO-19131

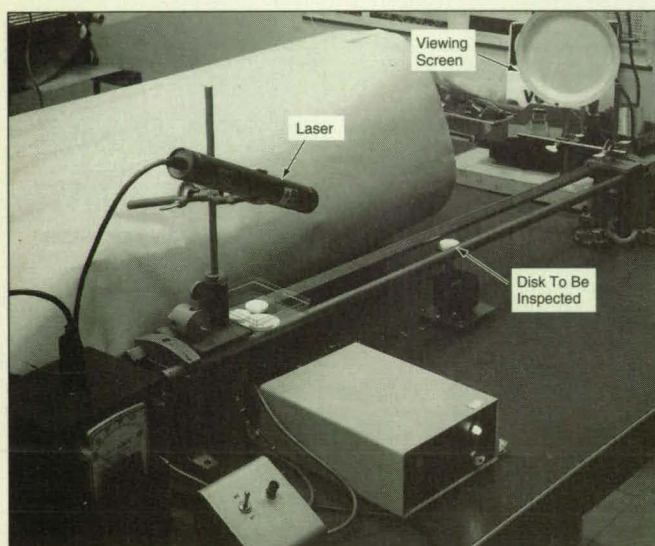


Figure 1. The Laser Beam Is Reflected from the surface to be inspected onto the viewing screen.

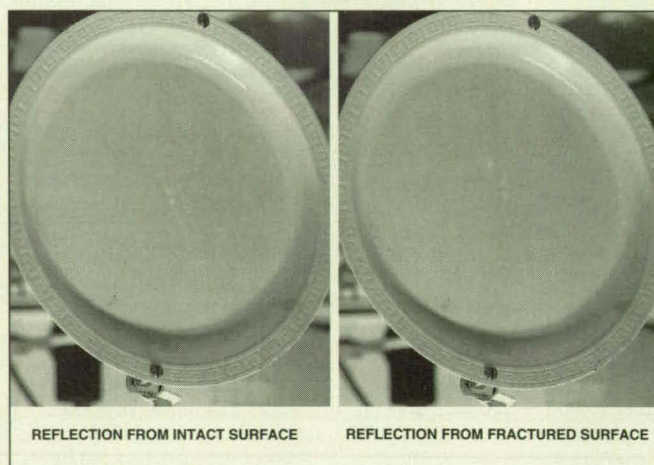


Figure 2. Reflection Patterns on the viewing screen illustrate the utility of the technique in revealing fractures.

Eddy-Current Detection of Cracks in Reinforced Carbon/Carbon

Invisible cracks can be detected nondestructively.

Lyndon B. Johnson Space Center, Houston, Texas

Investigations of failures of components made of reinforced carbon/carbon have shown that eddy-current flaw-detection techniques are applicable to these components. The investigation focused on space shuttle parts, but the findings should be applicable to other parts made of carbon/carbon materials: Indeed, eddy-current techniques are already used commercially to determine thicknesses of coating materials and

to detect discontinuities.

More specifically, the investigation showed that eddy-current techniques can reveal cracks, too small to be detected visually, in carbon/carbon matrix substrates and in silicon carbide coats on the substrates. Eddy-current techniques can also reveal delaminations in carbon/carbon matrices. Eddy-current techniques can also be used to characterize the extents and locations of discontinuities in sub-

strates in situations in which ultrasonic techniques and destructive techniques are not practical.

This work was done by Scott V. Christensen and Ajay M. Koshti of Rockwell International Corp. for Johnson Space Center. No further documentation is available. MSC-22479

HERE'S A BIG IDEA THAT'S ONLY ONE MICRON THICK!



Novamet HCA-1 Conductive Nickel Flake

Novamet HCA-1 Conductive Nickel Flake is Novamet's biggest selling conductive pigment. And for a very good reason. It is so conductive. Usually 0.1 ohm surface resistivity in dried acrylic surface coatings. Want a big idea for your resin...try Novamet HCA-1 Conductive Nickel Flake. For a free sample and data sheet, write to Novamet today.

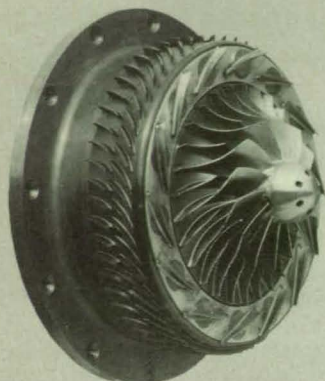
NOVAMET

Novamet Specialty Products Corporation
10 Lawlins Park, Wyckoff, NJ 07481
(201) 891-7976, Fax (201) 891-9467

For More Information Write In No. 519

AGILE TURBOMACHINERY SOLUTIONS

for Today & Tomorrow



As a global leader in compressor, turbine, and pump turbomachinery, we can assist you with a full range of services and products to meet your current and future needs.

Product Design, Development, Testing, and Troubleshooting

- Fluid and Mechanical Design
- Turbomachinery System Audits
- Field Equipment Troubleshooting
- CFD Analysis
- Finite Element Analysis
- Vibration Testing & Solutions (TAME™)
- Rotordynamic Evaluations
- Enhanced Predictive Maintenance
- Industrial Research Consortia
- World-Class Aero/Pump Laboratories
- Data Acquisition Systems

Integrated Design and Analysis Software for Compressors, Pumps, and Turbines

- Meanline Design Optimization
- Data Reduction
- Real Gas Properties and Mixtures
- 3D Geometry & Flow Modeling
- 3D FEA Structural Analysis
- CFD Analysis
- Integrated CAD & Rapid Prototyping

Educational Training and Publications

- We have instructed over 2,000 students from 300 companies in turbomachinery.

CONCEPTS ETI, INC.
education and technology for industry

4 Billings Farm Road
White River Junction, VT 05001
Phone: 802-296-2321 Fax: 802-296-2325

Apparent Thermal Conductivity of Multilayer Insulation

A mathematical model offers potential for optimization of design.

Lewis Research Center, Cleveland, Ohio

A mathematical model of the apparent or effective thermal conductivity between two successive layers of multilayer thermal insulation (MLI) offers potential for optimizing the performance of the insulation. Heretofore, efforts to design MLI blankets were focused on overall results, without detailed examination of the physical mechanisms by which heat is transferred across the gaps between layers. By using the present mathematical model in layer-by-layer calculations, one can gain an understanding of how each physical mechanism contributes to the overall flow of heat through an MLI blanket. With the help of the model, one can analyze engineering tradeoffs among such parameters as the number of layers, thicknesses of gaps between layers, types of spacers placed in the gaps, weight, overall thickness, and the effects of the foregoing on the apparent thermal conductivity through the blanket.

The mathematical model accounts for radiation across a gap, conduction through the gas in the gap, and conduction through solid separators that maintain the gap at a specified thickness. One version of the model comprises the following equation:

$$k = \sigma \left[\frac{\epsilon}{2 - \epsilon} \right] (T_w^2 + T_c^2) + \underbrace{\left(\frac{T_w + T_c}{4} - 4T_m^3 L_f / N \alpha^2 \right)}_{\text{(radiation)}} + \underbrace{0.007505P \left[1 - 0.2(T_w - 78) \right]}_{\text{(conduction in gas)}} + \underbrace{(0.01 / \Delta X) [0.017 + 7 \times 10^{-6} (800 - T_w) + 0.0228 \ln(T_w)]}_{\text{(conduction in separators)}}$$

where k = apparent thermal conductivity across the gap;

ϵ = emissivity of insulating layer;

σ = the Stefan-Boltzmann constant, $5.675 \text{ W m}^{-2} \text{ K}^{-4}$;

f = fraction of volume of the gap occupied by separator material;

T_w = temperature of the warmer layer of insulation, K;

T_c = temperature of the colder layer of insulation, K;

$T_m = (T_w + T_c) / 2$;

N = number of layers per unit thickness of blanket, m^{-1} ;

α = radiation absorptivity of the separator material;

P = pressure of gas in the gap, Pa;

ΔX = thickness of gap; and

L_f = apparent or effective size of separator pores.

The numerical values in the gas-conduction term are for nitrogen gas, while those in the separator-conduction term are from a curve fit to data on the thermal conduction of Dacron (or equivalent) polyethylene terephthalate. Typically, the separators consist of solid, round fibers laid parallel to each other in the gap, in which case $L_f = (\text{diameter of fiber}) \times [(\pi/4f) - 1]$. Alternatively, separators could be made in parallel strips, each covering about 10 percent of the total blanket area; multiple interlayers of this type could be laid out with strips crossed, so that only 1 percent of the total blanket area is available for conduction through the separator material.

The software to solve the equation layer by layer was undergoing refinement when the information for this article was submitted, and the coefficients may yet have to be adjusted somewhat to make the numerical results fit empirical data. Even so, the model has already yielded numerical results that suggest improvements in MLI design. In particular, the results have shown that to optimize overall performance, it is necessary to optimize local performance by varying the density of layers with depth within the blanket: the density of layers should be smallest near the colder side (where conduction through the separator material tends to predominate) and largest near the warmer side, where radiation tends to predominate.

This work was done by Glen E. McIntosh of Cryogenic Technical Services, Inc., for Lewis Research Center. For further information, write in 188 on the TSP Request Card. LEW-15594



Optimizing Misch-Metal Compositions in Metal Hydride Anodes

Optimization of compositions promotes retention of charge and discharge capacities.
NASA's Jet Propulsion Laboratory, Pasadena, California

Electrochemical cells based on metal hydride anodes have been investigated experimentally in an effort to find anode compositions that maximize charge/discharge-cycle performances. More specifically, the experimental anodes contained misch metal (a naturally occurring alloy of La, Ce, Nd, and Pr) alloyed with various proportions of Ni, Co, Mn, and Al, and the experiments were directed toward optimization of the composition of the misch metal (see table).

In preparation for fabrication of the experimental anodes, the alloys as received from the manufacturer were pulverized by ball milling, sifted, and preactivated by a few gas-phase hydrogen-absorption/desorption cycles. Carbonyl Ni powder in the proportion of 20 percent was mixed into each alloy powder as a conductive diluent. Then 5 percent of polytetrafluoroethylene powder was added to each powder mixture, and the anodes were fabricated by hot-pressing the mixtures.

The anodes were evaluated experimentally by charging and discharging them in all-glass prismatic cells with 31-percent-KOH electrolyte and Hg/HgO reference electrode. An important consideration in any such evaluation is that if a metal hydride cell is to operate at ambient atmospheric pressure, then the equilibrium pressure at which the metal alloy can absorb hydrogen should not exceed the ambient pressure. Accordingly, in the experiments, the anodes were charged at pressures close to ambient, and alloys for which the equilibrium pressures are higher (e.g., LaNi₅) were expected to exhibit low capacities.

As shown in the figure, the initial measured capacities were smaller for anodes in which the La contents of the misch-metal components were relatively high and greater for anodes in which the La contents were smaller. This trend can be explained in terms of a decrease in equilibrium pressure upon the substitution of Ce for La.

The capacities were then measured in

charge/discharge cycles at a 5-hour rate between -600 mV vs. Hg/HgO (considered to represent full discharge) and -1,200 mV vs. Hg/HgO (considered to represent full charge) with a charge return of 120 percent. The figure shows that the retention of capacity after numerous charge/discharge cycles was greater for the anodes with smaller La (larger Ce) contents. The optimum composition of the misch-metal component

appears to lie in the range of 25 to 30 mole percent of La and 50 to 55 mole percent of Ce, the balance being Nd (13 mole percent) and to some extent Pr (7 mole percent).

This work was done by Ratnakumar V. Bugga and Gerald Halpert of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 70 on the TSP Request Card. NPO-19325

Alloy Name	Misch-Metal Component				Al	Mn	Co	Ni
	La	Ce	Pr	Nd				
A	1.00	0.00	0.00	0.00	0.00	0.00	0.00	4.96
B	0.64	0.25	0.04	0.08	0.31	0.40	0.77	3.51
C	0.30	0.51	0.07	0.13	0.30	0.40	0.76	3.56
D	0.25	0.55	0.07	0.13	0.34	0.40	0.75	3.68

Table. The **Compositions of the Experimental Anode Alloys** differed mainly in the proportions of La and Ce within the misch-metal components. The proportions of the listed elements in the alloys are approximately equal to mole fractions relative to the number of moles of misch metal.

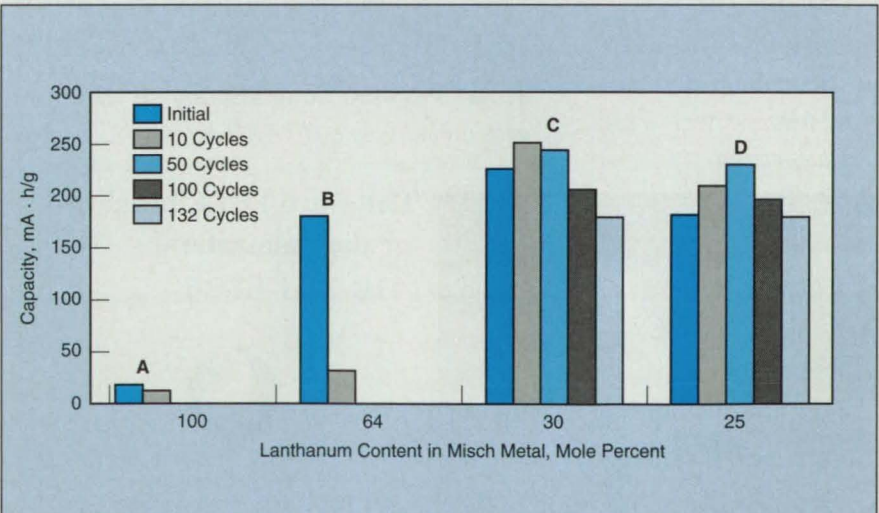


Figure. **Less La and More Ce in the Misch-Metal Components** of the anode alloys resulted in greater initial capacities and greater capacities retained after many charge/discharge cycles.

Device for Sampling Surface Contamination

A specially designed cotton swab is suitable for use in a clean room.

Marshall Space Flight Center, Alabama

The figure illustrates an easy-to-use contamination-sampling device in the form of a specially designed cotton swab. Unlike ordinary cotton swabs on wooden applicator tips, this device does not shed cotton and wood fibers, which would (if shed) further contaminate the inspected surface. The device satisfies clean-room standards.

The device includes a nylon-covered cotton tip on a wooden applicator dowel

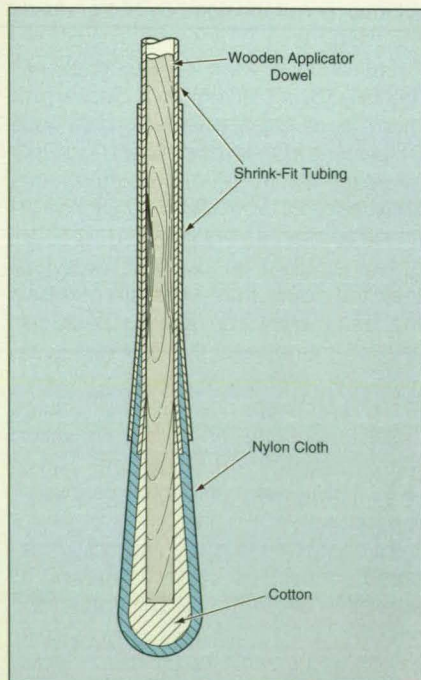
6 in. (15 cm) long. Most of the dowel and part of the cotton tip are covered with a shrink-fit plastic tube, which holds the nylon in place, retains wood fibers, and increases the diameter for a better grip. The tube has a nonslip finish. The tube-covered dowel is flexible and strong enough to withstand bending associated with sampling in relatively inaccessible recesses. The nylon fabric

covering the cotton tip (to retain cotton fibers) is held in place with another shorter piece of shrink-fit tubing. No glue (which could add contamination) is used in fabricating the device.

In the next-to-last stage of fabrication, the device is cleaned to remove hydrocarbons, which could contaminate the surface to be inspected and/or contribute spurious contamination readings. The cleaned device is then packaged in aluminum foil for storage until use. Before using the device, the foil package is removed but saved. The cotton tip is used to wipe the surface to be inspected, then the device is rewrapped in the foil package for transport to a laboratory for analysis of the contaminants picked up by the cotton tip. Typically, the contaminants are extracted from the cotton tip by use of a solvent.

This work was done by Felix A. Delgado and Susan M. Stern of Rockwell International Corp. for **Marshall Space Flight Center**. For further information, write in 42 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-30096.



The **Contamination-Sampling Device** is an improved version of the basic cotton-tipped wooden applicator, designed for extreme cleanliness and to enhance utility for sampling according to exacting specifications.

NEW!

Save Time & Money with the FREEPOINT 3D Digitizer

The Most Versatile and Affordable 3D Digitizer for:

- Rapid Prototyping
- Reverse Engineering
- Modeling
- Design
- Animation
- Measurement
- Inspection

FREEPOINT 3D

Real Time 3D Modeling Tool™



FREEDOM TO DIGITIZE IN 3 DIMENSIONS

Unique Digitizing Features:

- Large Volume – up to 16 x 8 x 8 ft.
- Digitize any material – including metals
- Hand-held Flexibility
- Portable

Broad Software Compatibility: Works with most leading 3D CAD software.

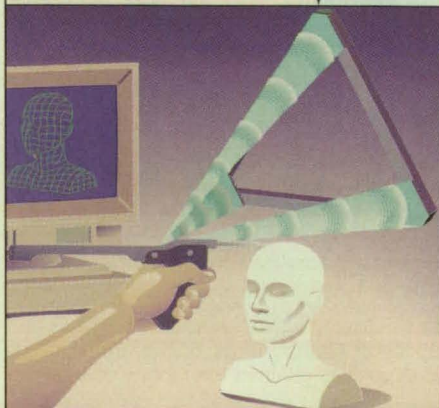
Call for a **FREE** brochure or demonstration!
410-381-6688

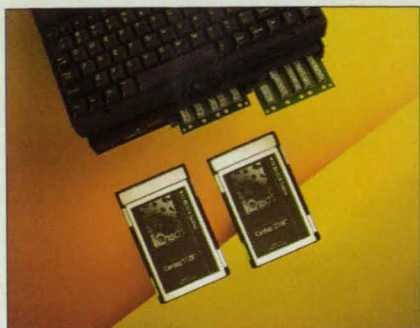


SCIENCE ACCESSORIES

New Dimensions In Digitizing

7125 RIVERWOOD DR. COLUMBIA, MD 21046
TEL 410-381-6688 FAX 410-290-9065





PCMCIA Data Acquisition Cards

The 100 kHz 12- and 16-bit Cardaq™ PCMCIA cards provide notebook PCs with 8 DE or 16 SE analog inputs (expandable to 256). They are available with compact signal conditioning (see ad at right), and can measure up to 256 signal inputs at 10 μ sec/channel. Software support includes DaqView™ and PostView™, DOS and Windows™ drivers, and Visual Basic™ VBXs. Drivers for icon-based software also provided. From \$695. IOtech, Inc. (216) 439-4091.

Write in No. 590



PC/IEEE 488.2 Controllers

The Personal488™ and Power488™ series include IEEE 488.2 interfaces for desktop PCs, notebook PCs, and PC/104 board-level computers. Software support includes DOS, Windows™, and Windows NT™ drivers for programming languages such as C, Pascal, Visual Basic™, and Quick Basic™. From \$395. IOtech, Inc. (216) 439-4091.

Write in No. 591



Tiny Serial/IEEE 488 Controller

The 2" x 2.3" Micro488/p™ enables any computer equipped with an RS-232 port to control up to eight IEEE 488 instruments. The miniature unit supports most standard IEEE 488 operations, draws its power from the serial port, automatically configures itself for the computer's baud rate, and features RS-232 and IEEE 488 connectors. \$395. IOtech, Inc. (216) 439-4091.

Write in No. 592

Low-Cost Sensor to PC

Interfacing for notebook & desktop PCs

Your Sensors & Signals



Support for most sensor & signal types

Signal Conditioning



Over 30 signal conditioning choices

A/D Converters

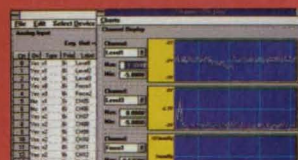


AT bus

PCMCIA

Parallel port

PC Software



Graphical applications & language drivers

Directly attach your sensors and signals to IOtech's portable or desktop PC-based data acquisition systems for fast and easy measurement and control. This complete sensor-to-PC solution allows you to combine any of the following signal conditioning options in one compact and low-cost system:

- thermocouple
- RTD
- strain gage
- accelerometer
- microphone
- pressure transducer
- LVDT
- millivolts to high-voltage
- 4-20 mA current loop
- isolation
- filtering
- simultaneous sample and hold
- frequency and pulse counting
- digital I/O
- relay

Complete your system with any of IOtech's wide selection of 12- or 16-bit, 100 kHz A/Ds for your desktop AT bus or your notebook PCMCIA slot or parallel port. All have programmable channel and gain sequencers, allowing you to easily mix up to 256 signals in one system, while maintaining a 10 μ sec/channel measurement rate.

Every IOtech PC-based data acquisition system includes FREE DaqView™ and PostView™ Windows™-based applications for graphical setup, acquisition, display, and storage to disk. You also get comprehensive drivers for DOS and Windows™ languages; Visual Basic™ VBXs; and drivers for LabVIEW®, Snap-Master™, DASyLab™, and LABTECH NOTEBOOK™.

Contact us today
for your free
IOtech catalog



(216) 439-4091
Fax (216) 439-4093



IOtech, Inc. • 25971 Cannon Rd. • Cleveland, OH 44146

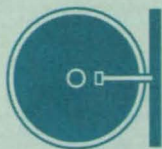
WORLDWIDE SALES: Australia, +61 3 579 3622; Austria, +43 (1) 259 72 70-0; Belgium, +32 (0) 2 466 81 99; Brazil, +55 11 853-2733; Canada, (905) 890-2010; Chile, +56 32 682 255; China, +86 1 205-9030; Denmark, +45 42 18 48 57; Eastern Europe, +43 1 54 515 88-0; Finland, +358 0 423911; France, +33 1 34 89 78 78; Germany, +49 711 79 80 37; Hong Kong, +852 2 830-5620; India, +91 80 6655 333; Israel, +972 03 498538; Italy, +39 2 66015566; Japan, +81 3-5688-6800; Korea, +82 2 538-4001; Netherlands, +31 (0) 70 399 6360; New Zealand, +64 9 309-2464; Southeast Asia, +65 482-5600; South Africa, +27 (12) 660-2884; Spain, +34 1 597 29 78; Sweden, +46 13 31 0140; Switzerland, +41 1 821.94.44; Taiwan, +886 2 5017065; United Kingdom, +44 (0) 1296 397676.

Prices and specifications may change without notice; prices are in U.S. dollars, F.O.B. Cleveland, Ohio, and do not include GST or duties, provincial taxes, freight and importation charges. The following are trademarks of their respective holders: C, DOS, Quick Basic, Windows, Visual Basic, Microsoft Corporation; DASyLab, DASyTEC GmbH; LABTECH NOTEBOOK, Laboratory Technologies; LabVIEW, National Instruments; Snap-Master, HEM Data Corporation; Pascal, Borland International.

At Bus Write in No. 593

PCMCIA Write in No. 594

Parallel Port Write in No. 595



Computer Programs

COSMIC: Transferring NASA Software

COSMIC, NASA'S Computer Software Management and Information Center, distributes software developed with NASA funding to industry, other government agencies and academia.

COSMIC's inventory is updated regularly; new programs are reported in *Tech Briefs*. For additional information on any of the programs described here, write in the appropriate TSP number.

If you don't find a program in this issue that meets your needs, call COSMIC directly for a free review of programs in your area of interest. You can also purchase the annual *COSMIC Software Catalog*, containing descriptions and ordering information for available software.

COSMIC is part of NASA's Technology Transfer Network.

COSMIC® —

Timothy L. Peacock, Director

Phone (706) 542-3265;

FAX (706) 542-4807

The University of Georgia,
382 East Broad Street,
Athens, Georgia 30602



Mechanics

Probabilistic Failure Assessment for Fatigue

This program contains nine subprograms that effect various components of fatigue analysis.

Probabilistic Failure Assessment for Fatigue (PFAFAT) is a package of software that utilizes the probabilistic failure-assessment (PFA) methodology to model high- and low-cycle-fatigue modes of failure of structural components. PFAFAT consists of nine programs. Three of the programs perform probabilistic fatigue analysis by means of Monte Carlo simulation. The other six programs are used for generating random processes, characterizing fatigue-life data pertaining to materials, and processing the outputs of computational simulations.

PFAFAT includes routines for the simulation of both high-cycle and low-cycle-fatigue cases. The example applications for the high-cycle-fatigue-analysis software include the following components of the main engine of the space shuttle: the main discharge duct of the high-pressure oxidizer turbopump (HPOTP), the main drive duct of the low-pressure fuel turbopump (LPFTP), and the heat-exchanger coil of the HPOTP. The PFAFAT software package includes programs to analyze elbow ducts with welds and straight ducts with welds and large differences in temperature across the duct walls. The example application for the low-cycle-fatigue-analysis software is the turbine disk of a high-pressure fuel turbopump.

The PFAFAT software package includes other programs for fatigue analysis. MATCHR is a program for simulating the cyclic fatigue behavior of a material, using fatigue-test data. This program

contains both the stress and strain formulations of the materials-characterization model in a stand-alone form. PFAFAT also includes a set of programs that compute the prior failure-distribution parameters and perform assurance calculations. Routines to implement the Bayesian statistical procedure are supplied. This procedure is used to combine operating experience with the prior failure distribution obtained from the probabilistic failure modeling. A number of random number generators are provided, including uniform, normal, gamma, beta, and Weibull distributions.

The probabilistic failure-assessment (PFA) methodology utilized by PFAFAT is an advanced approach for evaluating the risk of failure, assessing service life, and establishing design parameters for structures subject to fatigue failure. This approach combines engineering analysis with experience from tests and service to quantify the risk of failure. The PFA methodology is particularly valuable when information on which to base design analysis or prediction of failure is sparse, uncertain, or approximate and is expensive or difficult to acquire.

The PFA methodology is a prescribed statistical structure in which engineering analysis models that characterize failure phenomena are used in conjunction with uncertainties about analysis parameters and/or modeling accuracy to establish failure-probability distributions for specific failure modes. These distributions can then be modified by means of statistical procedures of the PFA methodology to reflect test or service experience.

The PFA methodology is applicable to failure modes of structures that can be analytically or empirically modeled. Engineering analysis models employed for design or prediction of failure due to specific failure modes are used in PFA. PFA can be applied at any time in the design, development, or operational phases of a program, using the information available. Sensitivity analyses conducted as a part of PFA can be used to evaluate alternative measures to control risks, thereby

enabling the more effective allocation of limited program resources. Such alternative measures can include changes in designs, testing, or inspections.

PFAFAT is written in FORTRAN 77 to be machine-independent. With minor modifications, it has been successfully implemented on a Sun4-series computer running SunOS, an HP9000-series 700 computer running HP-UX, an IBM PC-compatible computer running MS-DOS, a DEC VAX-series computer running VMS, and CRAY XMP-series computers running COS and UNICOS. It may be necessary to adjust the sizes of arrays, depending on the specific application; however, 5MB of main memory and 10MB of hard-disk space should be sufficient for most applications. The IMSL Libraries are necessary for compiling ABTFIT, one of the statistical-analysis programs. The standard distribution medium for PFAFAT is a 3.5-in. (8.89-cm), 1.44MB, MS-DOS diskette. Alternate distribution media and formats are available upon request. PFAFAT was under development from 1987 through 1992 and is a copyrighted work with all copyright vested in NASA.

This program was written by Nicholas Moore, Donald Ebbeler, Laura Newlin, Sravan Sutharshana, and Matthew Creager of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 63 on the TSP Request Card. NPO-18965

Probabilistic Fatigue and Flaw-Propagation Analysis

This program is an extension of the PFAFAT software.

Probabilistic Failure Assessment for Fatigue and Flaw Propagation (PFAFAT II) is a package of software that utilizes the probabilistic failure-assessment (PFA) methodology to model flaw-propagation and low-cycle-fatigue modes of failure of structural components. PFAFAT II compris-

ANNOUNCING

ANSYS 5.2

Take The Next Step.

<http://www.ansys.com>

autoFACT



1.800.937.3321

ANSYS

201 Johnson Rd. Houston, Pa 15342.1300

For More Information Write In No. 601

es one program for performing probabilistic crack-growth analysis and two programs for performing probabilistic low-cycle-fatigue analysis. These programs perform probabilistic fatigue and crack-propagation analysis by means of Monte Carlo simulation.

PFAFAT II is an extension of, rather than a replacement for, the PFAFAT software. The probabilistic fatigue- and flaw-propagation-analysis methodology implemented in PFAFAT II, plus the PFAFAT II software itself, are thoroughly documented. The statistical methodology is explained in the PFAFAT documentation. Programs from PFAFAT are required for generating random processes, charac-

terizing fatigue-life data pertaining to materials, and processing the outputs of computational simulations.

The crack-growth-analysis program in this software package can be used to probabilistically predict the crack-growth lives of structural components. Example applications include a Heat-Exchange (HEX) Coil and a plate Heat Exchanger (EXHEX). This code is very modular and hence can be easily modified for crack-growth analyses of various components. Different modules are provided for stress analysis and stress-intensity-factor calculations for the HEX and EXHEX analyses.

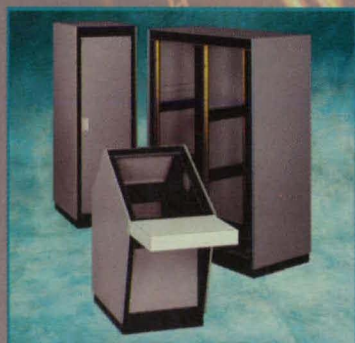
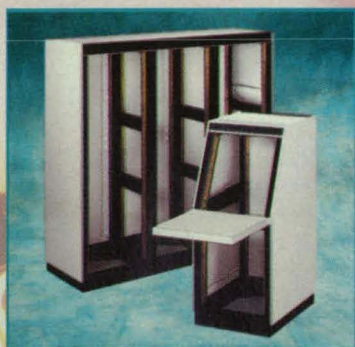
The low-cycle-fatigue (LCF) failure

model calculates the crack-initiation life of a structure subjected to a small number of high-amplitude load cycles. Values of such drivers as environmental parameters, loads, material properties, structural parameters, and uncertainties in driver values and engineering-model accuracy are used by the LCF failure model. The LCF-model example application is a program to analyze a turbopump turbine blade. There are two versions of the LCF model in PFAFAT II: One version follows a parametric approach to characterization of material fatigue data, while the other version follows a non-parametric or "bootstrapping" approach to characterization of fatigue-life data.

The probabilistic failure-assessment (PFA) methodology, which is utilized by PFAFAT and PFAFAT II, is an advanced approach for evaluating the risk of failure, assessing service life, and establishing design parameters for structures subject to fatigue failure. This approach combines engineering analysis with experience from tests and service to quantify the risk of failure. The PFA methodology is particularly valuable when information on which to base design analysis or prediction of failure is sparse, uncertain, or approximate and is expensive or difficult to acquire.

The PFA methodology is applicable to failure modes of structures that can be analytically or empirically modeled. Engineering analysis models employed for design or prediction of failure due to specific failure modes are used in PFA. PFA can be applied at any time in the design, development, or operational phases of a program, using the information available. Sensitivity analyses conducted as a part of PFA can be used to evaluate alternative measures to control risks, thereby enabling the more effective allocation of limited program resources. Such alternative measures can include changes in designs, testing, or inspections.

PFAFAT II is written in FORTRAN 77 to be machine-independent. It has been successfully implemented on a Sun4-series computer running SunOS, an HP 9000-series 720 computer running HP-UX, a CRAY Y-MP-series computer running UNICOS, a DECstation 3100-series computer running RISC ULTRIX, an IBM PC-compatible computer running DOS, an Intel Touchstone Delta-series computer running IPSC/860, and a DEC VAX-series computer running VMS. It may be necessary to adjust the sizes of arrays, depending on the specific application; however 5MB of random-access memory and 10MB of hard-disk space should be sufficient for most applications. The standard distribution medium for PFAFAT II is a 3.5-in. (8.89-cm), 1.44MB MS-DOS-format diskette. Alternate distribution media and formats are available upon request.



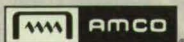
**YOU SAY YOU
NEED QUALITY
ENCLOSURES
FAST?
YOU'LL HAVE
THEM SHIPPED
IN FIVE
WORKING DAYS.**

AMCO is ready to help meet your needs with quality products that get to you FAST! Consoles? Computer desks? Desktop cabinets? Cooling devices? We can ship it to you from stock within 5 working days.

- Among our most popular stock offerings are 19" or 24" panel width vertical or sloped consoles.
- Black frames complimented by a rainbow of colors from gunmetal to cranberry!
- Stock desks and a range of accessories are also available.

Call today for the full AMCO Quick-Ship product line:

1-800-833-3156



Ask for FREE catalog or application assistance. There's a local AMCO rep in your area.

**See us at COMDEX/Fall, Las Vegas,
NV - 11/13-17, Booth #7119.**

PFAFAT II was under development from 1988 through 1992 and was released in 1993. This program is a copyrighted work with all copyright vested in NASA.

This program was written by Nicholas Moore, Laura Newlin, Donald Ebbeler, Sravan Sutharshana, and Matthew Creager of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 67 on the TSP Request Card. NPO-19319



Mathematics and Information Sciences

Windows Program for Driving the TDU-850 Printer

This program provides WYSIWYG compatibility between the video display and the printout.

PDW is a Microsoft Windows printer-driver computer program for use with the Raytheon TDU-850 printer. PDW provides a previously unavailable linkage between this printer and IBM PC-compatible com-

puters running Microsoft Windows. The PDW enhances the capabilities of the Raytheon TDU-850 hardcopier by emulating all of the textual and graphical features normally supported by laser/ink-jet printers and thereby making this printer compatible with any Microsoft Windows application. The PDW also provides capabilities not found in laser/ink-jet printer drivers by providing certain Windows applications with the ability to render high quality, true gray-scale photographic hardcopy on the TDU-850.

The user can be assured of a true WYSIWYG ("What you see is what you get") compatibility between the on-screen display of high-end application programs and the final printed images. PDW can be called upon by the Windows Graphical Device Interface (GDI) software to draw graphical objects (circles, lines, etc.) directly via the printer or to render graphical objects via shared memory so that the objects can then be copied to the video screen by screen-driver software. This enables Microsoft Windows, in conjunction with the screen-driver software, to provide maximum WYSIWYG fidelity while a document is being composed whenever PDW is selected.

PDW can reside simultaneously on as many as three separate personal com-

puters attached to a single Raytheon printer by use of the standard IEEE-488 general-purpose interface bus (GPIB) of the printer. PDW contains special software to determine whether other computers are contending for the bus before attempting to gain access to the printer.

PDW is written in C language for IBM PC-series and compatible computers running MS-DOS v4.0 or later and Microsoft Windows v3.0 or later. PDW also requires a National Instruments PC-compatible GPIB board and cable and a Raytheon TDU-850 printer. If it becomes necessary to modify the source code, then a Microsoft Quick C for Windows (or compatible) compiler must be used. The Microsoft UniTool may also be needed if the source code is being completely rewritten for another printer. An electronic copy of the documentation is available on the distribution medium in Microsoft Word for Windows format. The standard medium for distribution of PDW is a set of two 5.25-in. (13.335-cm), 360K MS-DOS-format diskettes. PDW was developed in 1993.

Footnote: The Raytheon TDU-850 hardcopier is a ruggedized, high-quality, gray-scale hardcopying device utilized on the space shuttle, military tanks, submarines, and the like. As purchased it is

Solid Modeling Simplified

CAD without clutter or complexity. Intergraph's **SOLID EDGE** gives you all of the capability and none of the confusion of traditional CAD systems. High-performance mechanical modeling in the comfortable, familiar Microsoft Windows® environment lets you spend more time designing, and less time operating a CAD system.



Next-generation interactive design tools. **SOLID EDGE** helps you design faster with innovative, intuitive mechanical modeling that is easy to learn and use. If you want to shorten learning curves, improve productivity, and reduce training costs, the clear choice is **SOLID EDGE**.

For the ease-of-use advantage, call **800-546-5550** or reach us on the Internet at <http://www.intergraph.com/mech/solidedge.shtml>.

INTERGRAPH
SOFTWARE SOLUTIONS



INTERGRAPH
SOLID EDGE

Intergraph and the Intergraph logo are registered trademarks and Solid Edge is a trademark of Intergraph Corporation. Microsoft and Windows are registered trademarks of Microsoft Corporation. Copyright 1995 Intergraph Corporation.

neither 'PC' nor 'Windows' compatible.

This program was written by Brett T. Parrish of Johnson Space Center. For further information, write in 65 on the TSP Request Card. MSC-22444

Subband/Transform MATLAB Functions for Processing Images

For example, the transforms can be used to prepare data for lossy compression.

The SUBTRANS software is a package of routines that implement image-data-processing functions for use with MATLAB* software. These functions provide the capability to transform image data with block transforms (such as the Walsh Hadamard) and to produce spatial-frequency subbands of the transformed data. Block transforms are equivalent to simple subband systems. Subband coding is a data-processing technique in which an original signal is transformed into several frequency bands. The classic method involves the use of a bank of digital filters to provide the frequency decomposition followed by decimators to reduce the total number of samples in all bands to the same (or nearly the same) number as the number of samples of the original signal. The low-frequency subband contains a low-resolution version of the original image, while the higher-frequency subbands contain information on edges.

The SUBTRANS functions can be cascaded to provide further decomposition into more subbands. If the cascade is applied to all four of the first-stage subbands (in the case of a four-band decomposition), a uniform structure of sixteen bands is obtained. If the cascade is applied to the low-frequency subband only, an octave structure of seven bands results. SUBTRANS also contains routines for the inverses of the transforms.

SUBTRANS functions can be used in image-data-compression systems. The transforms do not compress data, but they prepare the data for lossy compression by use of quantizer and statistical coders. Sample quantization functions for subbands are included in the software package. In a typical approach to compression of image data, one first transforms the data into subbands,

NASA 1995 Software of the Year Award

NASA's Inventions and Contributions Board has granted the second annual Software of the Year Award—which goes to authors of software created by or for NASA and used in its projects—to one winner and five finalists. And the winner is: Flow Analysis Software Toolkit (FAST) from Ames Research Center.

For all kinds of scientific visualization, researchers and engineers can turn to a program developed initially for analyzing computational fluid dynamics (CFD) data. Written by a team headed by branch chief Val Watson of Ames Research Center's Workstations Applications Office, FAST provides both exploration and exposition capabilities for analyzing CFD results and has found widespread use in the field. COSMIC's fourth-best seller in 1994, FAST is used by numerical aerodynamics simulation researchers at all ten NASA centers, over 40 aerospace companies, and universities—about 10,000 people in all.

The program owes much of its versatility to its modularity and highly interactive graphic interface. Building on earlier software called PLOT3D, a command-line program authored by a single programmer, FAST required dozens of programmers to create a high-end workstation program that turns any type of 3D data into 3D animation—aiding understanding of the often immense sets of data. It runs solely on Silicon Graphics IRIS 4D workstations.

FAST consists of a set of modules—each separate programs—that run simultaneously. By loading data files, performing data calculations and visualizing the results, and constructing scenes of 3D graphical objects, it lets the user view the results of numerical simulations. Although each of the minimally overlapping modules has a separate function, it can share data with the others. Flexible and extensible, FAST can be custom-configured—employing only the set of modules the user needs—and the designers continue to develop new modules.

The user also can create functional units in FAST. For example, the Field Calculator module allows the user to define functions for data reduction and display. Other modules include: Hub, the central inter-process-communication and shared-

memory manager, which starts modules; Viewer, which includes viewing transformations, color options, scaling, and animation; Surfer, for creating grid, scalar, and vector surfaces in computational space; Isolev, for creating a surface of constant scalar value and xyz cutting plane; and Audio, for acoustical display of scalar data.

Five finalists for Software of the Year are: Windows Visual News Reader from Kennedy Space Center, an Internet news reader; Jet Propulsion Laboratory's Controlled Optics Modeling Package (COMP) for optimal optics arrangement for segmented mirror configurations; Johnson Space Center's Information Sharing Protocol which shares real-time telemetry and remote access; the Common Data Format project from Goddard Space Flight Center that provides scientific data from NASA missions archived for the public on nine different computer platforms; and JPL's GIPSY-OASIS that uses global positioning satellite data to calculate the exact coordinates of any receiving point and a satellite's position.



FAST displays the space shuttle launch vehicle.

then quantizes the data, then uses statistical coding (e.g., run-length coding followed by Huffman coding) for compression.

The SUBTRANS functions were written for use in the MATLAB mathematical-analysis environment. (MATLAB is available from The MathWorks, Inc.) This software package is compatible with MATLAB 386 running on IBM PC-series and compatible computers; it also works under the UNIX version of MATLAB. An electronic copy of the documentation is provided in WordPerfect 5.1 format. The medium for distribution of this program is a 3.5-in. (8.89-cm), 1.44MB MS-DOS-format diskette. The contents of the diskette have been compressed by use of the PKWARE archiving software tools. The utility software to unarchive the files, PKUNZIP.EXE v2.04g, is included. This software package was developed in 1992.

* MATLAB is a trademark of The MathWorks, Inc.

This program was written by D. Glover of Lewis Research Center. For further information, write in 60 on the TSP Request Card. LEW-15891



Physical Sciences

Computing Equilibrium Chemical Compositions

This program aids calculation of thermodynamic properties of chemical systems.

The Chemical Equilibrium With Transport Properties, 1993 (CET93) computer program provides data on chemical-equilibrium compositions. Scientists and engineers need such data to calculate the theoretical thermodynamic properties of chemical systems. This information is essential in the design and analysis of such equipment as compressors, turbines, nozzles, engines, shock tubes, heat exchangers, and chemical-processing equipment.

For more than 40 years, the NASA Lewis Research Center has been involved in developing methods and computer programs for calculating complex chemical-equilibrium compositions and calculating thermodynamic and transport properties of the equilibrium mixtures, and for applying these properties to a

number of problems. CET93 is the latest of these computer programs. CET93/PC is a version of CET93 specifically designed to run within the 640K memory limit of the MS-DOS operating system.

CET93 is a general program that calculates chemical-equilibrium compositions and properties of mixtures for any chemical system for which thermodynamic data are available. Generally, mixtures may include condensed and gaseous products. CET93/PC performs the following operations:

1. It obtains chemical equilibrium compositions for assigned thermodynamic states.
 2. It calculates dilute-gas transport properties of complex chemical mixtures.
 3. It obtains Chapman-Jouguet detonation properties for gaseous species.
 4. It calculates incident- and reflected-shock properties in terms of assigned velocities or mach numbers.
 5. It calculates theoretical performances of rockets for both equilibrium and frozen compositions during expansion.
- The rocket-performance part of the program includes the option of assuming either a finite- or an infinite-area combustor. CET93/PC includes a file of thermodynamic data for over 1,100 gaseous and condensed species and a file of data on thermal-transport properties of 155 gas-

Freedom of Assembly

CAD for assembly.

Intergraph's **SOLID EDGE** goes beyond the part modeling approach of traditional CAD systems to improve assembly design productivity and quality. With specialized assembly design tools, you can model part-to-part relationships, analyze interference, and experiment with assembly configurations.



Design within the assembly.

With **SOLID EDGE**, you build a digital assembly prototype that helps you identify and eliminate design problems. Unique assembly navigation and management aids help you move quickly through large models, select the environment for your design task, and collaborate with assembly project teams. You can even build assemblies using parts from other CAD systems!

INTERGRAPH
SOFTWARE SOLUTIONS

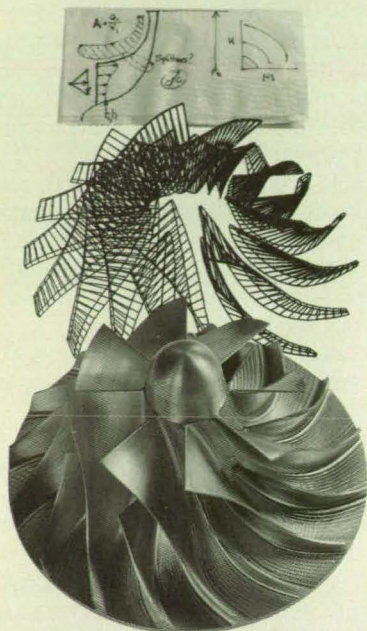


SOLID EDGE

Intergraph and the Intergraph logo are registered trademarks and Solid Edge is a trademark of Intergraph Corporation. Copyright 1995 Intergraph Corporation.

For the assembly design advantage,
call **800-546-5550**
or reach us on the Internet at
<http://www.intergraph.com/mech/solidedge.shtml>.

TURBOMACHINERY DEVELOPMENT MADE EASY



With advanced turbomachinery software systems from NREC you can balance performance, reliability, and cost.

Or, we can do it for you.

Product Design & Development

Services include product specification, feasibility studies, fluid and mechanical design, controls engineering, finite element analysis, rerating, performance upgrades, and failure analysis.

Specialized CAE/CAM Software

Advanced technology software improves design, performance prediction, vibration analysis, and N/C machining of compressors, pumps, and turbines.

Precision Manufacturing

NREC provides the highest quality 5-axis machining of complex impellers, rotors, blades, and blisks, up to 60 inches, plus balancing, spin testing, and assembly.

For More Information

Please request free literature or contact Frank Hines to discuss your application. Phone 617 937-4655 or Fax 617 935-9052.

NREC

Northern Research and Engineering Corporation

39 Olympia Avenue, Woburn MA 01801
A part of worldwide Ingersoll-Rand

eous species. These data are in the form of least-squares coefficients in binary form. Through use of a new "ONLY" option, the users can instruct CET93/PC to consider only particular species as possible products for a given equilibrium composition calculation. Relative to CET93, CET93/PC imposes a few limitations on the sizes of arrays so that it can run within the basic 640K of random-access memory (RAM) available under MS-DOS. The maximum number of possible reaction species accommodated for any chemical system was reduced from 600 to 300, and the maximum number of condensed reaction species was reduced from 300 to 200. Experience has shown, however, that even in the presence of these limits, CET93/PC is sufficient for most practical chemical systems.

CET93/PC is written in FORTRAN and is available only as executable code for use on IBM PC-series and compatible computers running MS-DOS. The executable code was created by use of Microsoft FORTRAN 5.1 on a 386SX PC without a math coprocessor; however, the executable code takes advantage of a math coprocessor when one is present. At least 400K of RAM must be available for this executable code to run properly. The distribution medium for CET93/PC includes input and output files for the example problems and two files that describe how to use the program. The paper documentation for CET93/PC consists of a copy of these instructions plus NASA Technical Memorandum 4557, which includes a list of the names of chemical species of possible products. The standard medium for distribution of CET93/PC is a 3.5-in. (8.89-cm), 1.44MB MS-DOS-format diskette. CET93/PC was developed in 1993.

This program was written by Bonnie J. McBride of Lewis Research Center, Sanford Gordon of Sanford Gordon and Associates, and Martin A. Reno of Heidelberg College. For further information, write in 95 on the TSP Request Card. LEW-16017

Program Processes Thermocouple Readings

Voltages are converted to temperatures.

The Digital Signal Processor for Thermocouples (DART) computer program implements a precise and fast method of converting voltage to temperature for large-temperature-range thermocouple applications. The conventional method of generating precise measurements requires multiple high-order equations that are difficult to solve in real time.

DART was written using LabVIEW software. Virtual instruments (VIs) were created by use of National Institute of Standards and Technology (NIST) tables, the precision of which is limited to 0.01 mV. Interpolation is used to generate more precise values. At NASA/Stennis Space Center, instrumentation in the field transmits information to a control room, where LabVIEW VIs display the data on computer monitors.

DART is available only as object code for use on Macintosh II FX or higher-series computers running System 7.0 or later and IBM PC-series and compatible computers running Microsoft Windows 3.1. The Macintosh version of DART (SSC-00032) requires LabVIEW 2.2.1 or 3.0 for execution. The IBM PC version (SSC-00031) requires LabVIEW 3.0 for Windows 3.1. LabVIEW requires a minimum of 5MB of random-access memory (RAM) on a Macintosh computer and 8MB of RAM on a PC. The LabVIEW software is a product of National Instruments (Austin, TX, 800-433-3488), and is not included with this program. The standard distribution medium for the Macintosh version of DART is a 3.5-in. (8.89-cm), 1.44MB diskette in Macintosh format. The standard distribution medium for the PC version of DART is a set of two 3.5-in. (8.89-cm), 1.44MB diskettes in MS-DOS format. DART was developed in 1994.

This program was written by Christine A. Quave and William "Bud" Nail III of Stennis Space Center.

For further information on SSC-00031, write in 55 on the TSP Request Card.

For further information on SSC-00032, write in 56 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Stennis Space Center; (601) 688-1929. Refer to SSC-00031/32.



Materials

ICAN — Second- Generation Integrated Composite Analyzer

This program computes stresses and strains in multilayer composites.

The Integrated Composite Analyzer (ICAN) computer program provides for comprehensive linear analyses of multilayered matrix/fiber composite materials.

The analyses include the features that are essential for effective design of structural components made of such materials. ICAN includes micromechanical design features to predict ply-level hygral, thermal, and mechanical properties. Laminate-analysis features are included to account for interply layer effects. ICAN integrates these with additional features to provide a capability for comprehensive analyses of composite structures.

ICAN also includes the following features: (1) ply stress-vs.-strain influence coefficients; (2) microstresses and microstrain influence coefficients; (3) concentration factors around a circular hole; (4) calculation of probable delamination locations around a circular hole; (5) Poisson's-ratio mismatch details near a straight edge; (6) free-edge stresses; (7) material card input for finite-element analysis by use of NASTRAN (also available from COSMIC) or MARC; (8) failure loads based on a maximum-stress criterion; (9) laminate failure stresses based on first-ply failures and fiber-breakage criteria; (10) transverse shear, normal, and interlaminar stresses; and (11) durability/fatigue-type analyses for thermal as well as mechanical cyclic loads. The code can assess degradation due to mechanical and thermal cyclic loads

with or without a defect. A modified version of ICAN that includes prediction of damping in polymer-matrix composites, ICAN/DAMP (LEW-15966, LEW-16073), is also available from COSMIC.

ICAN includes a dedicated data bank of constituent material properties that enables the user to build a data base of material properties of commonly used fibers and matrices. The user need only specify code names for constituents. Input to ICAN includes properties of constituent materials (or code names), factors that reflect the fabrication process, and geometry of the composite to be analyzed. Output includes the various properties of the plies and of the composite, the structural response of the composite, and the results of stress analysis of the composite with details of failure.

Two machine versions of ICAN are available; the Amdahl version and the PC version. The Amdahl version (LEW-15832) is written in FORTRAN 77 for Amdahl-series computers running VM. The Amdahl version has also been successfully ported to a variety of mainframes operating under different operating systems: VAX/VMS, CRAY/UNICOS, and ALLIANT. The most common difficulty experienced in converting this code to other systems is attributed to the differ-

ent conventions followed in allocating the various OPEN statements (input/output units) under individual operating systems. The Amdahl version requires 3.5MB of memory for execution. No sample executable code is provided.

The IBM PC version (LEW-15592) is written in FORTRAN 77 for use on the IBM PC-series computers running MS-DOS. Microsoft FORTRAN v5.1 is required to recompile the source code. For the IBM PC version, a sample executable code along with sample input and output is included on the distribution medium. Although the included executable code requires a math coprocessor, the ICAN source code can be compiled into an executable code that does not require a math coprocessor. The standard distribution medium for either version of ICAN is a 3.5-in. (8.89-cm), 1.44MB, MS-DOS-format diskette. ICAN was originally developed in 1986. The IBM PC version was released in 1992, and the Amdahl version was released in 1993.

This program was written by P. L. N. Murthy of Lewis Research Center and S. K. Mital of the University of Toledo. For further information, write in 5 on the TSP Request Card. LEW-15832

(continued on next page)

Open, Plug-and-Play CAD

CAD without

boundaries. Intergraph's **SOLID EDGE** breaks

the barriers between CAD and your other software.

It works hand-in-hand with spreadsheets, word processors, e-mail, and CAD/CAM/CAE programs.

With **SOLID EDGE** you can take advantage of a seamless, productive desktop for mechanical design that brings together all of your computer-aided tools.



A new way to integrate.

SOLID EDGE brings you

revolutionary plug-and-play integration

with hundreds of business, technical, and personal

productivity appli-

cations. With simple drag-and-drop, cut-and-

paste techniques, you can

readily link programs and freely share data. It's an entirely new paradigm for CAD integration that can dramatically change the way you automate design.

INTERGRAPH
SOFTWARE SOLUTIONS



INTERGRAPH
SOLID EDGE

Intergraph and the Intergraph logo are registered trademarks and Solid Edge is a trademark of Intergraph Corporation. Copyright 1995 Intergraph Corporation.

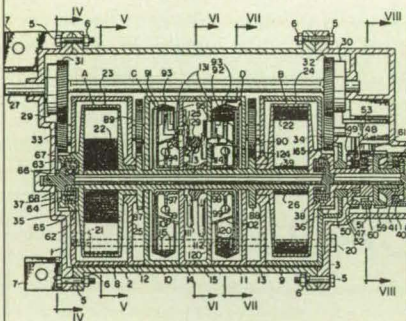
For the plug-and-play advantage, call **800-546-5550**

or reach us on the Internet at

<http://www.intergraph.com/mech/solidedge.shtml>

Your Japanese Competitor Just Issued Another Automotive Patent... Do You Know What It Is ?

集最新排行專



We Do!

And we've made it easy for you to find out. To stay abreast of all the Japanese—and rest of world—automotive patenting activities you need **Derwent's Automotive Patents Profiles**. For more information about this comprehensive source of automotive engineering patents, from braking systems to pollution control, call us at **(800)-451-3451** or circle the reader response number below. Or better yet, contact us at our Internet address **info@derwent.com**. Do it now and your next development move is sure to be a winner!



Integrated Composite Analyzer with Damping Capabilities

Damping properties are computed from equations of micromechanics.

The Integrated Composite Analyzer with Damping Capabilities (ICAN/DAMP) computer program combines the comprehensive linear analysis of a multilayered fiber composite material in ICAN (COSMIC programs LEW-15832, LEW-15592) with the prediction of damping in a polymer-matrix composite. As in ICAN, the analysis contains the essential features needed for effective design of structural components made from fiber composites, including micromechanical design features to predict ply-level hygral, thermal, and mechanical properties, and laminate-analysis features to account for interply layer effects. ICAN/DAMP incorporates a new module for synthesizing the material damping from micromechanics to the laminate level.

In ICAN/DAMP, explicit equations of micromechanics based on hysteretic damping are programmed to relate the on-axis damping capacities to the fiber and matrix properties and fiber volume ratio. The damping capacities of unidirectional composites subjected to off-axis loading are synthesized from on-axis damping values. The hygrothermal effects (that is, the effects of variations in temperature and moisture) on the damping performances of unidirectional composites are modeled along with the damping contributions from interfacial friction between broken fibers and matrices. The temperature rises in continuously vibrating composite plies and composite laminates are also estimated.

ICAN/DAMP is written in FORTRAN 77 for DEC VAX-series computers running VMS and Amdahl 5870-series computers running the VM/SP operating system. Sample input and output are provided. The standard distribution medium for the VAX version is a 1,600-bit/in. (630-bit/cm), 9-track magnetic tape in DEC VAX BACKUP format. It is also available on a TK50 tape cartridge in DEC VAX BACKUP format. The standard distribution medium for the Amdahl version is a 3.5-in. (8.89-cm), 1.44MB, MS-DOS-format diskette. ICAN was developed in 1986 and ICAN/DAMP was released in 1994.

This program was written by J. G. Sanfeliz, and C. C. Chamis of Lewis Research Center and D. A. Saravanas of Ohio Aerospace Institute. For further information, write in 6 on the TSP Request Card. LEW-15966



Electronic Components
and Circuits

Computing Efficiency of Transfer of Microwave Power

This program calculates electromagnetic fields in and between two apertures.

The BEAM computer program enables the user to calculate the microwave power-transfer efficiency between two circular apertures at an arbitrary range. The power-transfer efficiency is obtained numerically. The two apertures can have generally different sizes and arbitrary taper illuminations. BEAM can also analyze the effect of distance and taper illumination on the transmission efficiency for two apertures of equal size.

BEAM simulates the transmitting tangential aperture field with a tapered aperture field distribution. A numerical evaluation of the Kirchhoff and Helmholtz vector diffraction solution is used to calculate the distributions of the electric and magnetic fields at arbitrary observation distances. To obtain the transmission efficiency, the power transmitted is compared to the power intercepted by a receiving aperture antenna located at an arbitrary distance from the transmitting antenna.

BEAM is written in FORTRAN and was originally developed for Amdahl computers running VM/CMS. This version has been successfully compiled and implemented on an IBM 3080 computer running VM/CMS, a Sun4-series computer running SunOS, a DECstation 3100-series computer running DEC RISC ULTRIX, an HP9000 series-700 computer running HP-UX, an IBM PC-compatible computer running MS-DOS, and a DEC VAX-series computer running VMS. BEAM requires 1MB of random-access memory (RAM) and 3MB of virtual memory for execution on an IBM 3080 mainframe computer. It requires 238K of RAM for execution in a VMS environment, and approximately 408K of RAM for execution in UNIX and DOS environments. The standard distribution medium for this program is a 3.5-in. (8.89-cm), 1.44MB MS-DOS-format diskette. Alternate distribution media and formats are available upon request. No sample executable code is provided. BEAM was developed in 1989 and was released to COSMIC in 1993.

This program was written by L. R. Pinero and R. Acosta of Lewis

Research Center. For further information, **write in 58** on the TSP Request Card. LEW-15853

Program Calculates Power Demands of Electronic Designs

Overall currents and power levels are estimated from component current demands.

The CURRENT computer program calculates power requirements of electronic designs. For a given design, CURRENT reads in the applicable parts-list file and a file that contains the current required for each part. The program also calculates the power required for the circuit at supply potentials of 5.5, 5.0, and 4.5 volts.

The user invokes CURRENT with the input parts list, the current-requirements list, and the name of the output file. Any parts not in the current-requirement list are reported, and the current-requirement list can be modified for particular needs.

CURRENT is written by use of the AWK utility for Sun4-series computers

running SunOS 4.x and IBM PC-series and compatible computers running MS-DOS. The program was written to be used with the OrCad Schematic Capture Program, but also can be used with a list of parts in ASCII format. The UNIX "nawk" utility is used to run the Sun version of CURRENT. The Sun version of the program (NPO-19590) has been successfully implemented on a Sun4-series computer running SunOS 4.1.3. The PC version of the program (NPO-19111) has been successfully implemented on a DECpc 486-series computer running MS-DOS v6.2. A sample executable file is provided for the PC version of CURRENT. The standard distribution medium for the Sun version of CURRENT is a 3.5-in. (8.89-cm), 1.44MB diskette in UNIX tar format. The standard distribution medium for the PC version of CURRENT is one 3.5-in. (8.89-cm), 1.44MB, MS-DOS-format diskette. An electronic copy of the documentation in Microsoft Word v2.0 for MS-DOS format is included on all distribution media. CURRENT was released in 1995 and is a copyrighted work with all copyright vested in NASA.

This program was written by Brian Cox

of Caltech for **NASA's Jet Propulsion Laboratory.**

For further information on NPO-19590, **write in 68** on the TSP Request Card.

For further information on NPO-19111, **write in 69** on the TSP Request Card. NPO-19590/NPO-19111

Cost-Estimation Program

Costs of designs are estimated from design parts lists and files of unit costs.

The COSTIT computer program estimates the cost of an electronic design by reading an item-list file and a file that contains the cost for each item. The accuracy of the cost estimate is based on the accuracy of the cost-list file.

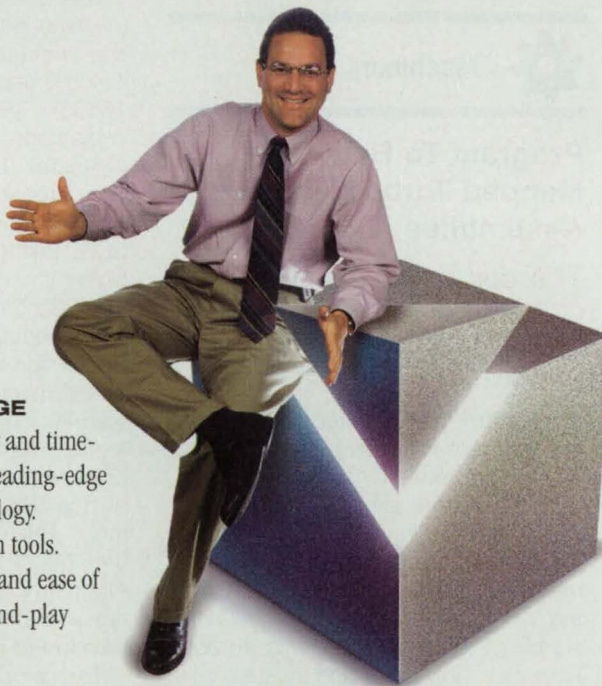
The user invokes COSTIT with the item-list file, the cost-list file, and the name of the output file. Any parts not in the cost list are reported, and the cost list can be modified for particular needs.

COSTIT is written by use of the AWK utility for Sun4-series computers running SunOS 4.x and IBM PC-series and compatible computers running MS-DOS.

CAD for the Leading Edge

Next-generation mechanical CAD.

Intergraph's **SOLID EDGE** brings you the productivity and time-to-market advantages of leading-edge mechanical design technology. Innovative assembly design tools. A new standard for power and ease of use. Revolutionary plug-and-play software integration.



Leading-edge value.

SOLID EDGE delivers breakthrough performance at a surprisingly affordable price. Built on advanced capabilities of the world's most popular, productive, and cost-effective computing environment, **SOLID EDGE** is an exceptional value that can help you gain and keep a competitive edge.

INTERGRAPH
SOFTWARE SOLUTIONS



SOLID EDGE

Intergraph and the Intergraph logo are registered trademarks and Solid Edge is a trademark of Intergraph Corporation. Copyright 1995 Intergraph Corporation.

For the leading edge advantage,
call **800-546-5550**
or reach us on the Internet at
[http://www.intergraph.com/
mech/solidedge.shtml](http://www.intergraph.com/mech/solidedge.shtml).

The program was written to be used with the OrCad Schematic Capture Program, but also can be used with a list of parts in ASCII format. The UNIX "nawk" utility is used to run the Sun version of COSTIT. The Sun version of the program (NPO-19587) has been successfully implemented on a Sun4-series computer running SunOS 4.1.3. The PC version of the program (NPO-19157) has been successfully implemented on a DECpc 486-series computer running MS-DOS v6.2. A sample executable file is provided for the PC version of COSTIT. The standard distribution medium for the Sun version of COSTIT is a 3.5-in. (8.89-cm), 1.44MB diskette in UNIX tar format. The standard distribution medium for the PC version of COSTIT is one 3.5-in. (8.89-cm), 1.44MB, MS-DOS-format diskette. An electronic copy of the documentation in Microsoft Word v2.0 for MS-DOS format is included on all distribution media. COSTIT was released in 1995 and is a copyrighted work with all copyright vested in NASA.

This program was written by Brian Cox of Caltech for NASA's Jet Propulsion Laboratory.

For further information on NPO-19587, write in 80 on the TSP Request Card.

For further information on NPO-19157, write in 81 on the TSP Request Card. NPO-19587/NPO-19157

Program Estimates Areas Required by Electronic Designs

Both unit areas of components and inherent additional space requirements are taken into account.

The PSIZE computer program calculates the space required for an electronic design. PSIZE reads in a parts-list file and a file that contains the required area for each type of part. A "reality factor" is applied to the calculated amount to account for the inherent additional space required by any layout.

The user invokes PSIZE with the input parts list, the component-size list, and the name of the output file. Any parts not in the component-size list are reported, and the component-size list can be modified for particular needs.

PSIZE is written by use of the AWK utility for Sun4-series computers running SunOS 4.x and IBM PC-series and compatible computers running MS-DOS. The program was written to be used with the OrCad Schematic

Capture Program, but also can be used with a list of parts in ASCII format. The UNIX "nawk" utility is used to run the Sun version of PSIZE. The Sun version of the program (NPO-19589) has been successfully implemented on a Sun4-series computer running SunOS 4.1.3. The PC version of the program (NPO-19065) has been successfully implemented on a DECpc 486-series computer running MS-DOS v6.2. A sample executable file is provided for the PC version of PSIZE. The standard distribution medium for the Sun version of PSIZE is a 3.5-in. (8.89-cm), 1.44MB diskette in UNIX tar format. The standard distribution medium for the PC version of PSIZE is one 3.5-in. (8.89-cm), 1.44MB, MS-DOS-format diskette. An electronic copy of the documentation in Microsoft Word v2.0 for MS-DOS format is included on all distribution media. PSIZE was released in 1995 and is a copyrighted work with all copyright vested in NASA.

This program was written by Brian Cox of Caltech for NASA's Jet Propulsion Laboratory.

For further information on NPO-19589, write in 45 on the TSP Request Card.

For further information on NPO-19065, write in 46 on the TSP Request Card. NPO-19589/NPO-19065



Machinery

Program To Balance Mapped Turbopump Assemblies

TPA computes outlet conditions and work from inlet conditions and performance maps.

Accurate computational simulation of nuclear thermal propulsion systems will enable reductions in testing and, thus, the time and cost of making these advanced systems ready for use in flight. An accurate simulation must maintain a "balance-of-plant" in which the required pump work equals the supplied turbine work. This turbopump-assembly balancing must be integrated into the overall system-analysis models. The TPA computer program was developed to balance turbine and pump work using performance maps. TPA requires input data on the inlet

properties, performance maps, and shaft speed. TPA then computes the exit conditions and work terms. The work terms can then be balanced by varying the input shaft speed.

The objective of the pump analysis is to determine (1) the state properties of the propellant at the exit from the pump and (2) the work done by the pump. The pump-analysis algorithm for liquid flow is based partly on the assumption that the shaft speed, the state properties of the propellant at the entrance to the pump, the rate of flow of propellant, the entrance and exit areas of the pump, and the pump-performance curves are all known. The analysis also requires both the pressure rise in the pump and the pump efficiency curves.

The objective of the turbine analysis is to determine (1) the propellant-state properties at the exit from the turbine and (2) the work done by the turbine. The turbine-analysis algorithm is based partly on the assumption that the shaft speed, the propellant-state properties at the entrance to the turbine, the rate of flow of the propellant, the root-mean-square diameter of the turbine blades, the entrance and exit areas of the turbine, and the turbine-performance curves are all known. The analysis also requires the turbine flow-parameter curve and the turbine total-efficiency curve.

TPA is written in FORTRAN 77 to be machine-independent. The TPA package includes the NBS+_PH2 code, which is also available separately (LEW-15505). TPA has been successfully implemented on a DEC VAX-series computer running VMS, a Sun4-series computer running SunOS, and an IBM PC-compatible computer running MS-DOS. Lahey F77L3 EM/32 v. 5.01 or higher is required for compilation on an IBM PC-compatible computer; however, a PC executable code is included on the distribution diskette. The standard distribution medium for this program is one 5.25-in. (13.34-cm), 360K, MS-DOS-format diskette. The contents of the diskette have been compressed by use of the PKWARE archiving software tools. The utility software to unarchive the file, PKUNZIP.EXE, is included. Alternate distribution media and formats are available upon request. TPA was developed in 1993.

This program was written by J. T. Walton of Lewis Research Center. For further information, write in 28 on the TSP Request Card. LEW-15712

Rapid Application
Development Environment
PV-WAVE[®] and Digital[™]

Awesome Power. Lightning Speed. Striking Precision.

Welcome to a high-voltage Rapid Application Development Environment (RADE[™])...with powerful new functionality from the PV-WAVE software family...maximized on AlphaStation[™] workstations from Digital[™].

RADE dramatically accelerates critical data visualization development projects by providing users with the fundamental components of application development. These components include an interactive language, reusable objects, powerful portability and robust graphic and numeric routines.

Bolt into another dimension with the lightning speed of the new line of AlphaStation workstations from Digital.

With the world's fastest microprocessor, coupled with next-generation system architecture, these workstations deliver superior development power with industry-leading price and performance.

Link Digital's open architecture and PV-WAVE's open environment and you're on the path of least resistance to a true Rapid Application Development Environment.

Transform your application development with Digital and PV-WAVE.

The results are electrifying.



Visual Numerics[®]



Call for your **FREE RADE Navigator Kit.**

1-800-447-7147

telephone: (303) 530-9000 • fax: (303) 530-9329
6230 Lookout Road, Boulder, CO 80301
e-mail: info@boulder.vni.com
CompuServe: go pwwave (at any ! prompt)
World Wide Web: <http://www.vni.com>

PV-WAVE is a registered U.S. Trademark of Visual Numerics, Inc. RADE is a trademark of Visual Numerics, Inc. AlphaStation and Digital are trademarks of Digital Equipment Corporation.

AD9517

London + 44 (0) 1753-790600 • **Paris** + 33 1 46 93 94 20
Stuttgart + 49 711-13287-0
Taiwan 886 (0) 2-727-2255 • **Tokyo** 81-3-5689-7550

For More Information Write In No. 611

One of the biggest threats to electronics is electricity.

To be more precise, static electricity.

Staticide is a long-term topical anti-stat that prevents costly damage caused by static build-up.

Ideal for use in electronic production areas, just spray or wipe Staticide on any surface where static concentrates. Completely, non-toxic, biodegradable and humidity independent, Staticide is a cleaner as well as an anti-stat.

Don't let static electricity threaten your business. Order Staticide today.



ISO 9002

Registered to:
ACL Inc., Cert. No. A3656



ACL Staticide
Specialists in Static Control

1960 E. Devon Ave.
Elk Grove Village, IL 60007
708-981-9212 Fax 708-981-9278
1-800-782-8420



**Mathematics and
Information Sciences**

BiblioTech

This program helps to retrieve and use data on diverse technological developments.

The BiblioTech computer program was originally developed to capture information about continuing advanced technological developments in fields applicable to spacecraft systems and subsystems in data-base files called "libraries." There is, however, no element of the design that restricts BiblioTech from addressing other technological fields beyond the specialized area of spacecraft technology. A BiblioTech data base can be used to determine what technologies are being developed by government institutions, laboratories, and private companies under government contract relating to spacecraft systems and subsystems. A data base also contains contact information to enable the user to gain more information about technologies in the library. The BiblioTech application program and the information contained in the BiblioTech libraries are dependent upon design and content inputs, which were provided by a variety of participating government agencies.

The BiblioTech system is composed of two interrelated elements. The first is the BiblioTech application program, which is a relational data-base-management system based upon the 4th DIMENSION environment. BiblioTech comprises data-base structure and code that implements functional capability for input, display, output, query and report generation, analysis, and maintenance. The second element consists of one or more populated libraries. These are data files, with spacecraft-subsystem-technology entries, supplied by a variety of developing agencies.

A library can refer to several different technology application areas, or different application areas can be maintained in separate libraries, using the same BiblioTech application program to manage their content and use. The overall organization of the library for local use depends upon the manner in which an organization intends to use it to support its technology-development programs.

The content and functions of BiblioTech specifically provide for the following: (1) determining the identity, status, and goals of technological items within the community of organizations that supply input to the library; (2) capturing information on programs being planned

or developed at the local user organization; (3) developing material for periodic program-status reviews; (4) assessing the ability of proposed programs to supplement or augment developments by other organizations, while avoiding conflict or duplication of effort; and (5) creating and maintaining a definitive list of organizational contacts for each item in the library.

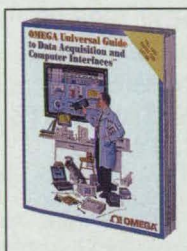
BiblioTech is a data-base program and is available only as executable code for use with 4th DIMENSION Runtime on Macintosh computers running System 6.0.7 or later. This program requires at least a Macintosh SE computer with 4MB of random-access memory and 8MB of hard-disk memory space; however, it is recommended that BiblioTech be installed on Macintosh II or better to improve execution speed. There are three modules of BiblioTech for which licenses are required: 4D Runtime 2.2.3, 4D CALC 1.1, and 4D Communications Kit 1.0. These modules provide the basic data-base engine, spreadsheet, and communications capabilities required to operate BiblioTech. The data-base and communications modules are included on the BiblioTech distribution medium but will be operable only after the user obtains licenses for them. The spreadsheet module, 4D CALC, will be provided by the licensor and placed into the BiblioTech application program during the licensing procedure. Licenses for 4D CALC 1.1 and 4D Runtime 2.2.3 are available from ACI US, Inc. (Cupertino, CA, 408-252-4444). The license for 4D Communications Kit 1.0 is available from Full Moon Software (San Jose, CA, 408-253-7199).

BiblioTech also requires installation of Apple's Macintosh Communications Toolbox and Macintosh Basic Connectivity Set. In addition, an AppleTalk-compatible network and a modem will be necessary if the ability to communicate with other BiblioTech sites is desired. The Communications Toolbox is distributed as part of Apple's Macintosh System 7. The Communications Toolbox, Basic Connectivity Set, and MacTCP 1.1.1 are also available from Apple Computer, Inc. (Cupertino, CA, 408-996-1010). The standard distribution medium for this package of software is a set of five 3.5-in. (8.89-cm), 800K Macintosh-format diskettes. BiblioTech was developed in 1993 and is a copyrighted work with all copyright vested in NASA.

This program was written by David S. Mittman and Phillip R. Turner of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 61 on the TSP Request Card. NPO-19112

DESIGN ENGINEERING PRODUCT SHOWCASE

New Products and Services for NASA Tech Briefs readers. For more information, write in the corresponding number on the Reader Action Request Form (page 97).



OMEGA UNIVERSAL GUIDE TO DATA ACQUISITION & COMPUTER INTERFACES™

OMEGA Engineering Inc. is pleased to announce the release of its latest publication, OMEGA Universal Guide to Data Acquisition and Computer Interfaces, Fall 1995/Winter 1996 edition. Products that can be found in the book include: alarm monitors, auto-dialers, communication adapters and converters, dataloggers, parallel interfaces, PLCs, plug-in boards, serial interfaces, signal conditioners, and software.

OMEGA Engineering Inc.

For More Information Write In No. 300



COLLECT FOR WINDOWS DATA COLLECTION THROUGH RS-232

Collect for Windows allows you to collect data from virtually any RS-232 instrument, and put it directly into programs such as Excel, Lotus 1-2-3, Quattro Pro and others. Multiple applications may be open and receiving data simultaneously from different instruments. As data is received in your application, calculations can be performed instantly and the results displayed. For more information on this new product, contact OMEGA, or use our OMEGAfaxSM service to request Document #6335 by calling 1-800-848-4271 from any Touch-Tone phone.

OMEGA Engineering Inc.

For More Information Write In No. 301



SINGLE-CHANNEL ASYNCHRONOUS SERIAL INTERFACE

OMEGA introduces the OMG-ULTRA-485 single-channel RS422/485 asynchronous serial interface. The OMG-ULTRA-485 is an ideal interface for factory automation equipment and PLC communication. The ULTRA-485 is perceived by the system to be an RS-232 port, so no special software drivers are required. Maximum data communication distance between PCs is 5000 ft., coupled with data rates up to 115K BPS.

OMEGA Engineering Inc.

For More Information Write In No. 302

HIGH-SPEED ISOLATED TEMPERATURE/VOLTAGE INTERFACE



The OMB-MULTISCAN-1200 features channel-to-channel isolation for temperature and voltage measurements. Its high-speed scan rate allows the operator to scan temperature and voltage inputs at a rate of 147 channels per second. System expansion up to 744 channels is available through low-cost expansion chassis.

OMEGA Engineering Inc.

For More Information Write In No. 303

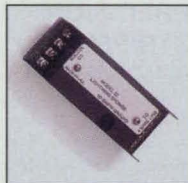


HIGH-RESOLUTION PLUG-IN BOARD FOR IBM PCS AND COMPATIBLES

The new WB-ASC16 Series boards from OMEGA provide eight channels of 16-bit analog input for a wide variety of input types. Three models are available in this series. The WB-ASC16-TC accepts thermocouple, millivolt and voltage signals directly. The WB-ASC16-GP accepts both millivolt and voltage inputs. The WB-ASC16-RTD accepts RTD temperature sensors directly. All boards also include eight channels of digital I/O individually programmable as input or output.

OMEGA Engineering Inc.

For More Information Write In No. 304

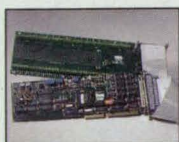


LIGHTNING/SURGE PROTECTORS GUARD AGAINST HIGH-VOLTAGE TRANSIENTS

The new CAT-22 Series lightning/surge sponges are designed to accommodate high voltage transients caused by lightning or other electrical disturbances that can easily destroy semiconductor junctions. The CAT-22 Series redirects these transients to earth ground. The protection circuits incorporate multiple separate stages of limiting high voltage transients: gas tubes, avalanche diodes, and MOV thyristors.

OMEGA Engineering Inc.

For More Information Write In No. 305



DAS-1800 PLUG-IN BOARDS FOR IBM-COMPATIBLE COMPUTERS

The DAS-1800 Series plug-in boards feature continuous, high-speed, gap-free data acquisition under Windows or DOS. An on-board FIFO buffer and dual-channel DMA allow the acquisition of large amounts of data without losing data. The DAS-1800HC models feature 64 single-ended inputs of 32 differential inputs at up to 333 ksamples/sec. The DAS-1800ST has maximum acquisition at different gains, pre-post and about triggering, two analog outputs and digital I/O.

OMEGA Engineering Inc.

For More Information Write In No. 306

VOLTAGE INPUT BOARD OFFERS PLUG-IN SOLUTION



The new model DAS-TC is an easy-to-use, highly accurate IBM PC and compatible plug-in solution for measuring thermocouple and voltage inputs. Up to 16 differential inputs are provided as well as one cold junction compensation (CJC) sensor input. Automatic calibration, gain selection, CJC thermocouple linearization conversion to degrees or volts and averaging are performed by an on-board microprocessor. To connect signals to DAS-TC, accessories provide screw terminal connections for all I/O lines.

OMEGA Engineering Inc.

For More Information Write In No. 307



HIGH-SPEED DATA ACQUISITION FOR NOTEBOOK/DESKTOP PCS

The OMB-DAQBOOK-100 plug attaches directly to the parallel port on the PC. It can transfer data bi-directionally at up to 170 Kb/sec. The unit provides the following features: 16 analog inputs, expandable to 256; 2 analog outputs; 24 general-purpose I/O channels, expandable to 192; 16 high-speed digital inputs; and 5 frequency/pulse I/O channels.

OMEGA Engineering Inc.

For More Information Write In No. 308



AUTOMATION CONTROLS & COMPONENTS

New Automation Controls & Components Selector Guide provides overview of pneumatic and electronic industrial automation components and controls available from Festo. Over 90 product categories in 24-page brochure, covering control systems, PLCs, Fieldbus manifolds, sensors, pneumatic cylinders, valves and accessories. Education/Training programs in automation control technologies described. Contact: Festo Corporation, 395 Moreland Road, Hauppauge, NY 11788; Tel: 516-435-0800.

Festo Corporation

For More Information Write In No. 310

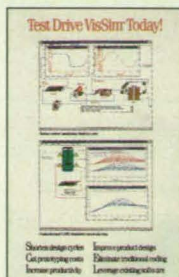


PARTS EXPRESS

Our FREE catalog features 212 pages packed with electronic parts for the do-it-yourselfer. Over 12,000 items including speakers, semiconductors, tools, wire, capacitors, hardware, test equipment, kits, connectors, adhesives, educational books and videos, TV parts, and much more. Call toll free 800-338-0531. Parts Express, 340 E. First St., Dayton, OH 45402.



For More Information Write In No. 311



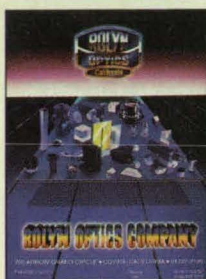
QUIT GUESSING SIMULATE IT WITH VISSIM™

VisSim is an innovative block diagram language for nonlinear dynamic simulation. VisSim's uniquely integrated approach to model construction and execution leads to rapid prototyping, faster execution, and greater productivity. NEW! Version 2.0 has MMI. Call:

508-392-0100 or Fax: 508-692-3102. Visual Solutions, Inc., 487 Groton Rd., Westford, MA 01886. FREE WORKING DEMO.

Visual Solutions, Inc.

For More Information Write In No. 312



FREE CATALOG "OPTICS FOR INDUSTRY"

Free 130 page catalog from Rolyn, world's largest supplier of "Off-the-Shelf" optics. 24-hour delivery of simple or compound lenses, filters, prisms, mirrors, beamsplitters, reticles, objectives, eyepieces, plus thousands of other stock items. At off-the-shelf prices. Rolyn also supplies custom products and coatings in prototype or production quantities.

Rolyn Optics

706 Arrow Grand Circle, Covina, CA 91722-2199
Tel: 818-915-5707; Fax: 818-915-1379.

For More Information Write In No. 313



MONITOR, RECORD & ANALYZE

Astro-Med's 32-channel recorder with built-in monitor, 170 Mbyte internal hard drive and front-panel floppy drive is described in this illustrated 20-page brochure. The unit, called the MT95K2, features extraordinary capabilities including three on-board analysis programs, Windows host control, Windows data analysis, and a wide variety of sophisticated data capture options. Tel: 800-343-4039; Fax: 401-822-2430.

Astro-Med Inc.

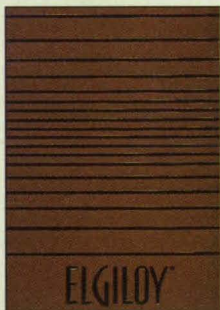
For More Information Write In No. 314



NEW 1995-96 COLE-PARMER® INSTRUMENTS CATALOG

The new, free 1995-96 Cole-Parmer Instruments catalog contains over 1700 full-color pages and features more than 40,000 products covering scientific instruments, equipment, and supplies. The catalog includes a detailed 40-page product index and table of contents, informative introductory pages for many of the catalog sections, "Hot Tips," and an 8-page section of late-breaking products. Contact Cole-Parmer Instrument Company—in the USA or Canada, call toll-free 1-800-323-4340.

For More Information Write In No. 315



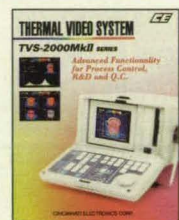
PRECISION STRIP/WIRE

Elgiloy® is a combination strip and wire mill. We process a variety of alloys including Inconel®, Hastelloy®, Monel®, MP35N®, Titanium and Stainless. Our sales and engineering staffs are qualified to handle your custom material requirements, and our on site testing lab assures you

of prompt deliveries. Tel: 708-695-1900; Fax: 708-695-0169.

Elgiloy® Limited Partnership

For More Information Write In No. 316



INFRARED IMAGING SYSTEM

Cincinnati Electronics introduces the TVS-2000MKII infrared imaging system with superior infrared sensing technology and processing electronics to provide a flexible tool for process control, R&D, and quality control. System features are: 12-bit data storage, area emissivity correction, histogram, time vs. temperature trending, multiple image display, image subtraction, multiple temperature point readout, alarms, and multiple optics. Combined with our inexpensive analysis software, the TVS-2000STMKII is the solution to many infrared imaging problems.

Cincinnati Electronics Corp.

For More Information Write In No. 317



MECHANICAL COMPONENTS

PIC Design's new Catalog 43 is bigger than ever—288 pages, including new Modular Framing Elements, Linear Motion Systems & Positioning Tables, and expanded lines of Lead Screws & Nuts, Belts & Pulleys, Ball Slides, Shoulder Screws, Bearings, Shafting, Couplings and much more, all in inch and metric dimensions. PO Box 1004, Middlebury, CT 06762. Tel: 800-243-6125; Fax: 203-758-8271; E-mail: info@picdesign.com.

PIC Design

For More Information Write In No. 318



Hardigg Cases offers over 225 standard rotationally molded transit cases, including a full line of 19" EIA rack mount cases, deck cases, and flange-mount cases. Hardigg's expert engineering, manufacturing, and test facilities provide start to finish custom design capability. A complete list of standard cases allows for rapid delivery...as few as three working days! Take advantage of over forty years of experience...design a Hardigg case into your next project!

HARDIGG CASES

Tel: 1-800-JHARDIGG; Fax: 413-665-8061

For More Information Write In No. 319



Ball Screws & Actuators

New DA95 catalog offers 288 different "ready to use" precision acme and precision ball screw drives. Screw drives come totally assembled with machined ends, precision end bearings and feature standard NEMA motor mounts and couplings. Complete linear slides featuring precision rail assemblies are offered in seven sizes with strokes to 135 inches. CAD files are available to speed designs. Contact: Greg Traeger, Sales Manager, Ball Screws & Actuators, San Jose, CA 95136. Tel: 800-882-8857.

For More Information Write In No. 320

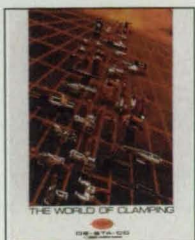


FIBERGLASS LAMINATED EPOXY 155 °C

Design Data pamphlet features materials, properties, and tolerances for glass epoxy components. It shows designers how to specify from open stock tools, for potting forms, bobbins, coil forms, structural, and circuit board manufacturing aids. Stevens Products, Inc., 128 N. Park St., E. Orange, NJ 07019. Tel: 201-672-2140.

Stevens Products, Inc.

For More Information Write In No. 321



WORLD OF CLAMPING

The World of Clamping Catalog 5/95 describes and illustrates toggle and special clamps with vertical and horizontal hold-down, straight-line, latch, and squeeze action. Spacing products, hydraulic devices, and CAD

databases are covered, along with applications. De-Sta-Co, Box 2800, Troy, MI 48007; Tel: 800-245-2759.

De-Sta-Co

For More Information Write In No. 322



ESDU UPDATE

The newsletter of ESDU (Engineering Sciences Data Unit) International PLC, ESDU Update keeps engineers informed about the latest developments in engineering design data. This first issue focused on Aerospace Engineering, although design software development and the

Chemical, Structural and Mechanical Engineering fields also are central to ESDU's areas of expertise. ESDU International PLC, 27 Corsham St., London N1 6UA, England; ESDU sales hotline: 44 (0) 171 490 5151.

ESDU International PLC

For More Information Write In No. 325



HOUDINI MULTIMEDIA TRAINING FOR AUTOMATIC CAD TO 8-NODE FEA

Learn to use Houdini to automatically produce 8-node "brick" finite element models from CAD solid models for analysis by any FEA software. The video tape and interactive CD-ROM pack a lot of information into just 32 minutes. Training notes from Algor's 2-day Houdini seminar and actual models used in training are included on the CD-ROM. Tel: 412-967-2700; URL: <http://www.algor.com>; E-mail: info@algor.com.

Algor, Inc.

For More Information Write In No. 328



SOLENOID ENGINEERING MANUAL

New catalog from Deltrol Controls features complete product and engineering information for your solenoid selection. Their complete line includes: C-Frames, D-

Frames, Tubulars, Clappers, and Power Surge solenoids ranging from standard to custom designs. AC and DC standard coil values are specified with duty cycles ranging from continuous to intermittent to pulse. Deltrol Controls; Tel: 800-DELTROL (800-335-8765).

Deltrol Controls

For More Information Write In No. 331

STOCKED BELLOWS CONTACT SPRINGS



Brochure presents data on Servometer's line of 13 stocked bellows type contact springs which range from OD's of 0.037 in. to 0.125 in. diameter. Overall lengths from 0.055 to 0.197 with compression capabilities from 0.012 to 0.072 inches. Low self-inductance. Gold-plated for conductivity. Brochure and sample bellows available. Servometer Corp., 501 Little Falls Rd., Cedar Grove, NJ 07009-1291; Tel: 800-785-4630; Fax: 800-785-0756.

Servometer Corp.

For More Information Write In No. 323

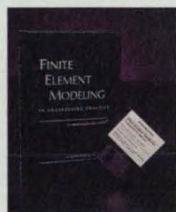
VACUUM PUMP VIBRATION ISOLATORS



The NEC vibration isolators effectively remove turbo-molecular and cryopump vibrations. Two models are available in elastomer and air-isolated versions. They are UHV compatible, have short insertion lengths, and high conductance. A wide variety of flanges are available. National Electrostatics Corp., Graber Rd., PO Box 310, Middleton, WI 53562-0310; Tel: 608-831-7600; Fax: 608-256-4103.

National Electrostatics Corp.

For More Information Write In No. 326



BOOK WITH DISK DELIVERS REAL-WORLD FEA INSTRUCTION

A comprehensive FEA reference/textbook that offers a unique blend of theory & real-world engineering examples. Dr.

Constantine Spyarakos, well-known finite element stress & vibration analysis expert, has created a reference for all mechanical engineers from designers to "gurus." Richly illustrated hardcover book includes every example problem on a disk. Subjects include: FEA basics, element types, modeling, types of analysis & the interpretation of results. Tel: 1-800-482-5467; URL: <http://www.algor.com/apd.htm>; E-mail: apd@algor.com.

APD

For More Information Write In No. 329



VIBRATION ISOLATION & IMPACT ABSORPTION BREAKTHRU

New, color brochure describes the dynamic properties of Sorbothane, the unique vibration isolation and impact absorption material. New test

data details damping properties of Sorbothane compared to other elastomers. Sorbothane is a patented visco-elastic polymer. Included are new vibration isolation/shock absorption products, and manufacturing, applications engineering and other applications in which Sorbothane can be found. For more information, or to receive a free brochure & sample, call 216-678-9444; Fax: 216-768-1303.

Sorbothane, Inc.

For More Information Write In No. 332



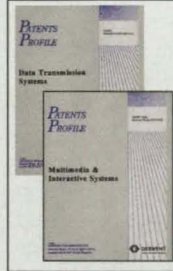
PCMCIA READER/WRITER WITH SCSI INTERFACE

The MCDISK Series of SCSI READER/WRITERS from MPL-AG allows the user to use TYPES I, II, or III Memory cards with PCs, Apple, UNIX, HP, or SUN systems with SCSI inter-

faces. Both internal and external models are available. Also, all types of PCMCIA Memory cards are available to support the MCDISK units. Tel: 800-368-6971; Fax: 602-892-0029.

Envoy Data Corporation

For More Information Write In No. 324



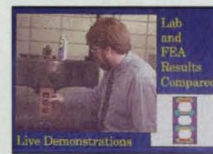
INNOVATIONS WITHIN TELECOMMUNICATIONS

Each month, Derwent publishes eight printed profiles containing the latest patents within the Telecommunications industry. Subjects covered include Data Transmission Systems, Mobile/Cellular

Telephones, Optical Communications, ISDN and Data Exchange Networks, Multimedia and Interactive systems. The profiles provide an ideal medium to monitor global competition, determine market gaps or form potential partnerships. Derwent North America; Tel: 800-451-3451; E-mail: info@derwent.com.

Derwent North America

For More Information Write In No. 327



NEW KIND OF MULTIMEDIA VIDEO TEACHES FEA LESSONS

Finite Element Analysis in Action! is a new kind of instructional video for engineers. Available on VHS tape or interactive, multimedia CD-ROM, the video packs a lot of information into a short running time of only 26 minutes. Live lab experiments and FEA analysis are conducted to show how to better use any FEA software. Demonstrates specific modeling and analysis techniques. Tel: 1-800-482-5467; URL: <http://www.algor.com/apd.htm>; E-mail: apd@algor.com.

APD

For More Information Write In No. 330



NEW FROM PLAN HOLD INTERNATIONAL! THE DIGITAL MEDIA STORAGE SYSTEM®

The premier manufacturer of storage systems for large drawings, plots and other documents now introduces the same high-quality products for digital media storage and organization. Protect valuable 1/4", 4mm, 8mm, 1/2" magnetic tape cassettes, cartridges or reels, optical disks, CDs, magnetic disks, audio/visual and micro-form media. Plan Hold International; Tel: 800-854-7081; Fax: 800-739-6869.

Plan Hold International

For More Information Write In No. 333



Controlling Mirror Tilt With a Bimorph Actuator

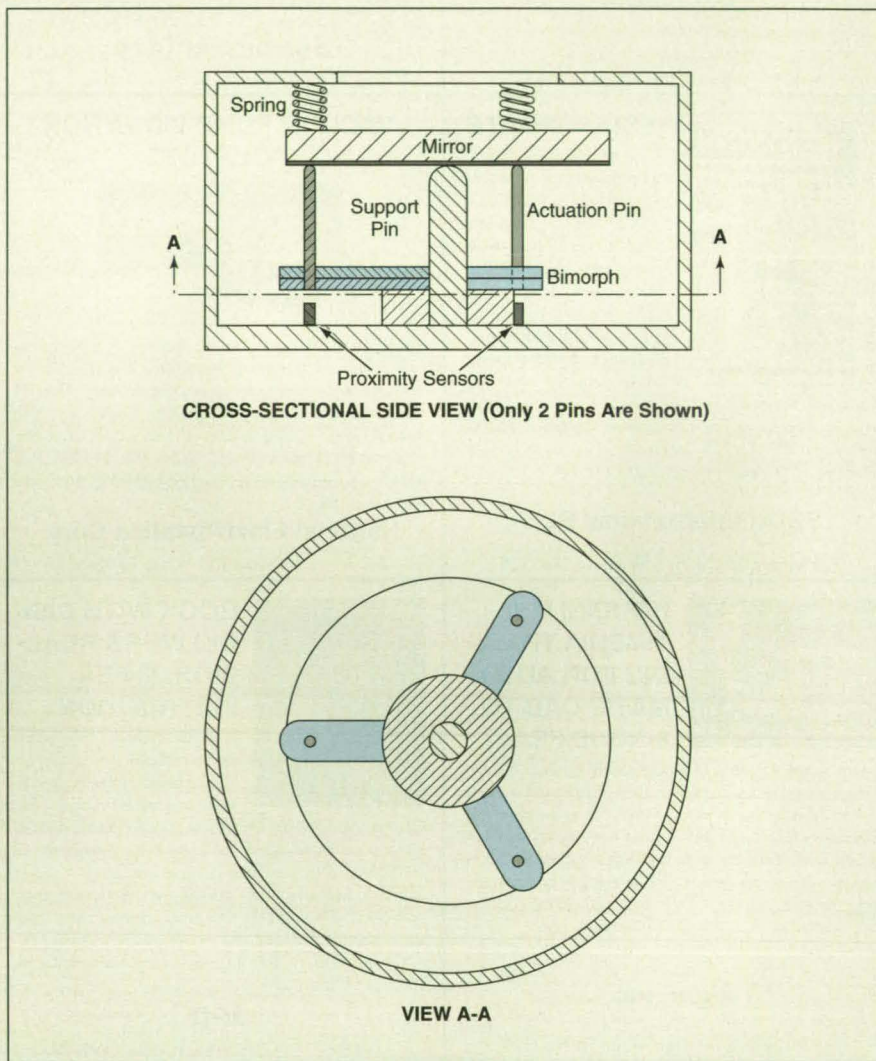
Advantages would include light weight, small size, and low power.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed mirror-tilting actuator would be based on bimorph cells. (A conventional bimorph cell is typically a unit in which two thin plates of piezo-electric material are cemented together so that when a voltage is applied, one plate expands and the other contracts, causing the unit to bend.) The actuator could be used to provide controllable tilt of a mirror in a copy machine or optical scanner, for example. In comparison with other mirror-tilting actuators based on stacks of piezoelectric and/or electrostrictive transducers, this one would be smaller and lighter, and in comparison with some of them, it would demand less voltage and power to produce equivalent tilts.

The figure illustrates the proposed actuator as installed behind a circular mirror. The actuator would include three bimorph cells at equal angular intervals. A separate voltage would be applied to each bimorph; thus, each bimorph could be bent independently of the other two, making it possible to tilt the mirror about either or both of the two perpendicular tilt axes to any angle within range. One end of an actuation pin would be anchored near the free tip of each bimorph, which would push on the back of the mirror via the pin. The mirror end of each pin would be hemispherical.

Bimorphs are commercially available. A typical commercial bimorph can be like the conventional bimorph described above or it can be made of a layer of either piezoelectric or electrostrictive material (piezoceramic) bonded to a single layer of metal. A commercial bimorph can be bent as much as 6 to 10 milliradians by an applied potential of about 50 V. At relatively low actuation frequencies, a maximum power of about 4 W and a maximum potential of about 50 V would be needed to drive an actuator based on such bimorphs. Because commercial bimorphs are only about 0.5 mm thick, an actuator containing them could be relatively compact, and doublet or triplet sets of bimorphs could be stacked to provide redundancy in case



Three Bimorphs would be excited by individually or collectively applied voltages. This would cause the bimorphs to bend, with resultant tilting of the mirror, or translation of the mirror forward or backward as desired.

of a failure of one bimorph. The mass of the complete actuator would be only a few grams.

The proposed actuator would include a microprocessor that would determine the desired direction, speed, and maximum tilt angle and convert these data to control signals. A multiplexer would apply the control signals to circuits that would apply the actuation voltages to the individual bimorphs. Capacitive or eddy-current proximity sensors would

provide tilt feedback, helping to ensure the accurate response of the actuators and mirror in the face of hysteresis and other variables that could affect actuator performance.

This work was done by Yoseph Bar-Cohen of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 54 on the TSP Request Card. NPO-19303

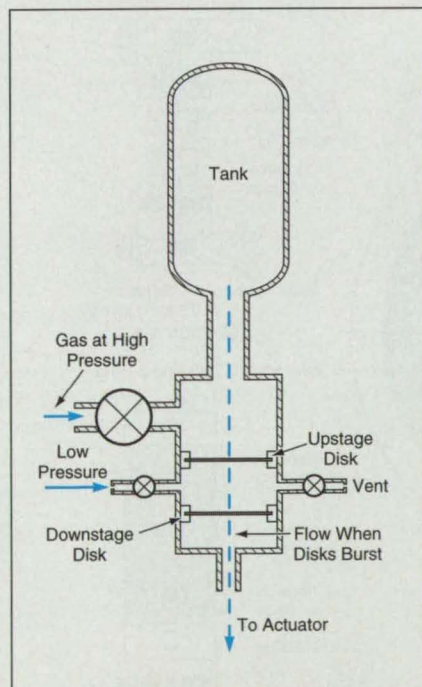
Burst-Disk Device Simulates Effect of Pyrotechnic Device

Expendable disks are substituted for costly pyrotechnic devices for testing actuators.

Lyndon B. Johnson Space Center, Houston, Texas

A burst-disk device produces a rush of pressurized gas similar to that produced by a pyrotechnic device. The burst-disk device was designed to reduce the cost of testing pyrotechnically driven emergency actuators (parachute-deploying mechanisms in the original application). The cost of replacing burst disks is much less than that of replacing pyrotechnic devices.

The device consists of a pressure chamber and associated plumbing (see figure). The chamber includes two burst disks; an upstage disk and a downstage disk, both designed to burst at a pressure of 3,569.50 psi (24.611 MPa). The space upstream of the upstage disk is connected via a wide pipe to a tank, which acts as a buffer or reservoir that supplies the rush of pressurized gas to the actuator when the device is operated. The space downstream of the



The **Upstage and Downstage Disks Burst** in rapid succession when the pressurized gas in the space between them is vented. The resulting sudden flow of pressurized gas drives the actuator.

Thin, Strong, Lightweight

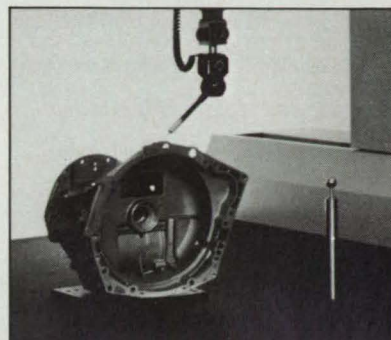
Flexible, endless stainless steel belts for driving, conveying, timing, positioning. Excellent strength-to-weight ratios; up to 280,000 psi tensile strength. Widths 1mm to 20", thicknesses .002" to .030", any length from 6" up.



METAL BELTS

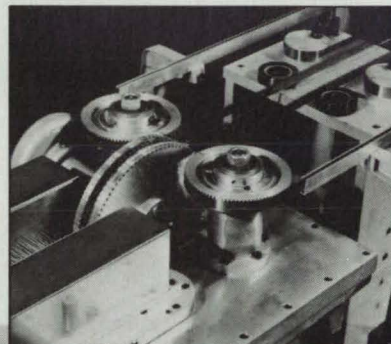
Precision Positioning

Virtually nonstretchable belts and two-ended drive tapes for indexing, timing, sensing and positioning with nearly zero backlash and position error. Smaller, simpler, lighter, less costly and more accurate than lead screws, gear trains, articulated arms, etc.



Special Advantages

Metal belts are ideal for automated manufacturing: inert, non-absorbent, easily cleaned; suitable for corrosive environments or clean rooms. Excellent high temp resistance, also thermally conductive for heat sealing and heat transfer applications. Electrically conductive, static-free.



Designed for You

Perforations for sprocket driving, vacuum conveying, optical sensing. PTFE and other coatings for lubricity or surface protection. Pins, studs, mounting pads and other attachments for special capabilities. Many choices of metals, properties, pulleys and sprockets. Just tell us what you need to do!



BELT
TECHNOLOGIES

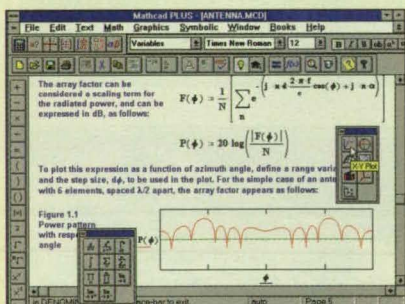
11 Bowles Road, P.O. Box 468, Agawam, MA 01001-0468 USA
TEL. (413) 786-9922 (800) 528-6262 FAX (413) 789-2786

Metal Belts That Drive Productivity



New Mathcad 6.0. It's not just a new version. It's a new vision.

It's the first complete problem-solving environment that lets you explore, analyze, model, test, refine and document even the most complex technical problems. Collaborate using E-mail, Lotus Notes® and the World Wide Web. Enter equations on the screen in real math notation using hundreds of built-in functions, change variables and instantly update answers, then print out your work in presentation-quality documents. Choose new Mathcad® 6.0



Mathcad 6.0 solves the most complex problems, from start to finish, in an intuitive and highly usable interface.

Standard Edition, now with animation, statistics and more data analysis tools. Or new 6.0 Professional Edition with added power, including live symbolics, differential equations, and unique operators that let you program in a language you already know - math.

For a Free Working Model call 1-800-827-1263

or download a copy from

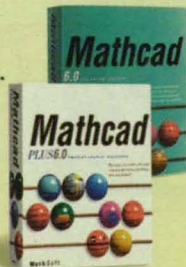
<http://www.mathsoft.com>.

Or visit your reseller today.

Once you see Mathcad 6.0,

you'll never look at math

the same way again.



EGGHEAD SOFTWARE

COMPUTER

COMPUSA

MathSoft, Inc. 101 Main St., Cambridge, MA 02142 USA • Tel: 617-577-3017 • Fax: 617-577-8829

MathSoft Europe, Box 12358, Edinburgh, EH11 4GN, UK • Tel: +44-131-451-6719

Fax: +44-131-458-6986 • © 1995 MathSoft, Inc. TM and ® signify manufacturer's

trademark or registered trademark respectively.

A45B3

downstage disk is connected via a pipe to the actuator that is to be driven by the rush of pressurized gas.

Initially, the space between the disks is pressurized with the gas to 700 psi (4.8 MPa). Then the space upstream of the upstage disk is pressurized with the gas to 4,000 psi (27.6 MPa). Once the pressure has settled to a steady value, the differential pressure across the upstage disk is then 3,300 psi (22.8 MPa) — somewhat below the bursting pressure.

At the time for testing, the gas is vented slowly from the space between the disks, making the pressure across the

upstage disk rise toward the upstream pressure of 4,000 psi (27.6 MPa). Eventually, this pressure exceeds the bursting pressure, causing the upstage disk to burst. The sudden rush of high-pressure gas immediately bursts the downstage disk and flows to the actuator.

This work was done by James P. Rogers and James H. Sexton of Rockwell International Corp. for Johnson Space Center. For further information, write in 59 on the TSP Request Card. MSC-22407

Bearing-Mounting Concept Accommodates Thermal Expansion

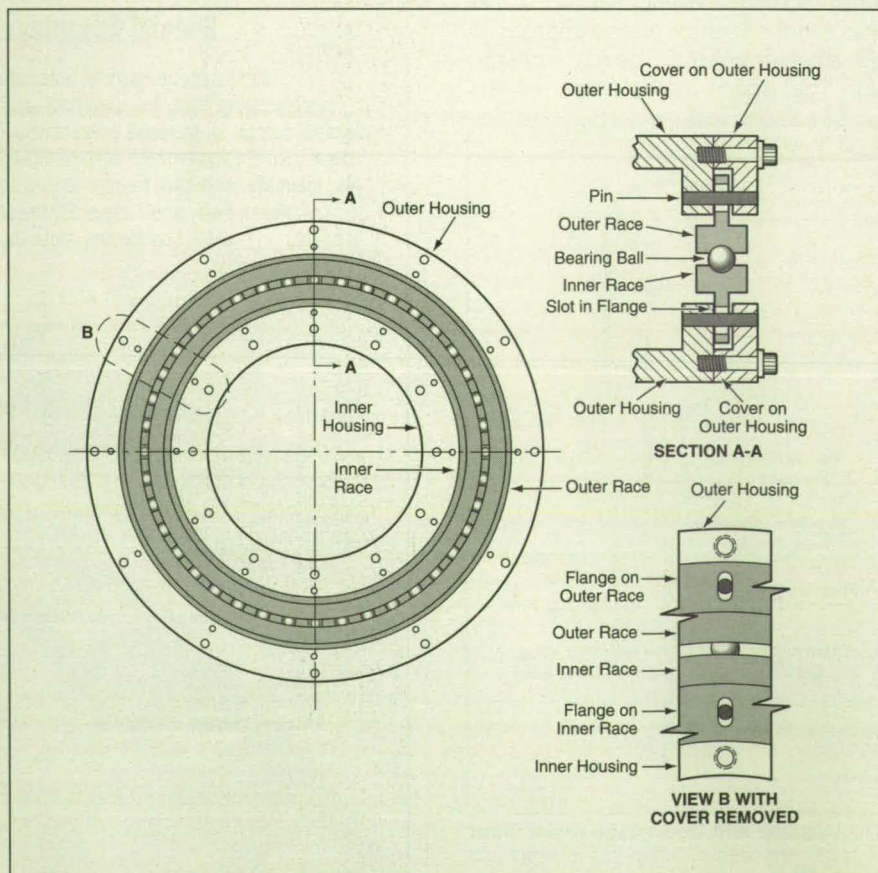
Pins or splines allow radial expansion without slippage.

Lyndon B. Johnson Space Center, Houston, Texas

A design concept for mounting a rotary bearing accommodates differential thermal expansion between the bearing and any structure(s) to which the bearing is connected. Differential thermal expansion can be significant

when, for example, a bearing is made of steel while the inner and outer races of the bearing are connected to housings made of aluminum, which expands at almost twice the rate of steel.

The present design concept prevents



Pins Fixed in the Housings mate with radial slots in the flanges on the bearing races. The mating of pins and slots allows differential thermal expansion while maintaining concentricity.

Complete Containment for corrosive and hard-to-handle fluids

PFA Fittings, Tubing, and Valves from the SWAGELOK companies let you design leak-tight systems from start to finish.

SWAGELOK® PFA Tube Fittings

- Leak-tight seals with high pressure capability
- 1/4", 3/8", and 1/2" sizes
- Pressures to 275 psig

SWAGELOK PFA Tubing

- 1/4", 3/8", and 1/2" sizes
- 0.062" wall thickness
- 50 ft. and 100 ft. lengths

SWAGELOK Groove Cutter

For grooving PFA Tubing used in SWAGELOK PFA Tube Fittings.

WHITEY® PFA Valves

Needle

- Roddable, straight-through orifice for easy cleaning and high flow (C_v 's to 1.39)
- 1/4", 3/8", and 1/2" SWAGELOK Tube Fitting end connections
- Plug tip stem ensures leak-tight shut-off and offers flow control
- Positive stem stop prevents accidental disassembly
- Panel mountable
- Patented stem seal eliminates leakage and requires less operating torque
- Pressures to 180 psig
- Temperatures to 300°F

Plug

- 1/4 turn actuation
- Easily cleaned or purged
- Full flow design ($C_v = 1.8$)
- Compact
- 1/4" SWAGELOK Tube Fitting end connections
- Pressure rating 60 psig
- Temperatures to 200°F



Grooved PFA Tubing for leak-tight seal.

No visible gap between nut and body hexes - with hexes aligned - ensures proper makeup.



SWAGELOK Co.
Solon, OH 44139

the buildup of thermal stresses by allowing thermal expansion to occur freely but accommodating the expansion in such a way as not to introduce looseness. In one version shown in the figure, the bearing races include integral flanges that fit loosely into the inner and outer housings. Each flange includes multiple radial slots just wide enough for a sliding fit with pins in the corresponding housing. Each slot is elongated in the radial direction to accommodate the differential thermal expansion between the bearing and the housing.

The contact between the pins and the edges of the slots ensures that each housing and the corresponding bearing race rotate together. This pin-in-slot configuration also maintains concentricity. In an alternative version, the pins and slots are replaced by mating radial splines, which function similarly.

This work was done by Robert Nespodzany and Toren S. Davis of Honeywell, Inc., for Johnson Space Center. For further information, write in 53 on the TSP Request Card.

Title to this invention has been waived

under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457(f)), to Honeywell, Inc. Inquiries concerning licenses for its commercial development should be addressed to:

*Thomas Rendous
Office of General Counsel
Honeywell, Inc.
Honeywell Plaza
P.O. Box 524*

Minneapolis, MN 55440-0524

Refer to MSC-22414, volume and number of this NASA Tech Briefs issue, and the page number.



**Here's the clincher
for anyone who
designs for assembly.**

Less is more. Less parts, less assembly steps, less assembly time – all yield more productivity and more cost reductions. To achieve this, designing for assembly (DFA) is critical.

PEM® products address this requirement. Just punch or drill a hole and press a PEM fastener into place. PEM self-clinching fasteners install permanently into this sheets. There are fewer parts and fewer total pieces to handle during assembly. We offer threadless and multi-function fasteners to further meet your DFA needs. These include SNAP-TOP® (shown in

photo above) standoffs which eliminate the need for screws, locating pins for quick alignment of mating parts, P.C. board fasteners and many others.

If you want less to give you more, contact us at: **1-800-237-4736**. We can show you how PEM fasteners and presses can help you meet your DFA needs.

For instant info, call:

The PEMFAX™ Information System

1-800-736-6863

Specify document number 7131

Clinch it with PEM®
FASTENERS & PRESSES

Penn Engineering & Manufacturing Corp.
P.O. Box 1000 • Danboro, PA 18916-1000

©1995

Parallel-Plate Acoustic Absorbers for Hot Environments

Stacking patterns and materials would be chosen to suppress noise.

*Lewis Research Center,
Cleveland, Ohio*

Acoustic liners that incorporate parallel-plate absorbing elements have been proposed for use in suppressing broadband aerodynamic noise that originates in flows of hot gases in ducts. One potential application lies in suppressing the noise generated in the exhaust-jet mixer/ejectors in the propulsion system of the proposed High-Speed Civil Transport. In addition, such absorbers might be useful in any situation in which high temperature limits the use of such conventional resonant acoustic-liner materials as perforated face sheets bonded to honeycomb-core panels.

Because the parallel-plate liners would exploit viscous dissipation within narrow channels, there would be no need for face sheets. The main reason for using the parallel-plate configuration instead of other configurations is to inhibit the transfer of heat and thus inhibit the degradation of materials at high temperatures.

The absorption efficiency and frequency response would depend on a number of parameters, including (but not limited to) the widths and depths of the channels, the porosity (in terms of the fraction of total volume occupied by the channels), surface textures, and the total internal channel-surface area per unit volume of liner. Materials and fabrication techniques would determine the ranges of these parameters. The orientations of the channels would likely affect the development of boundary-layer flows thus affecting flow losses.

FOR EVERY SENSING CHALLENGE, THERE'S A SUNX SOLUTION

EX-10 SUPER-SLIM PHOTOELECTRIC SENSORS.

Save space with self-contained output and direct PLC interface. A 500mm sensing range and a Waterproof IP67 enclosure combine for big-time performance in a 3.5mm thick unit.

CX-20 COMPACT-SIZE PHOTOELECTRIC SENSORS.

Though 20% smaller than comparable units, the CX series offers a 10m sensing range and transparent object detection. Ideal for all presence-sensing applications.

PM SERIES LIMITED-DISTANCE, DIFFUSE AND SLOT-TYPE MICROPHOTO SENSORS.

Self-contained unit detects dark pieces and microscopic objects. Operation is not influenced by background or object color.

CY CYLINDRICAL PHOTOELECTRONIC SENSORS.

Small and compact, these Waterproof IP67 sensors are ideal for specular, opaque, translucent, and transparent object-detection applications.

GXL INDUCTIVE PROXIMITY SENSORS.

Built-in amplifier saves space. Provides reliable performance for counting and positioning applications.

**COMPACT SIZE
HIGH RELIABILITY
LONG-RANGE SENSING
COST-EFFECTIVE
EASY INSTALLATION**

FX-7 FIBER OPTIC SENSORS.

On/off push button tuning simplifies sensitivity setup. Resolution 8x higher than comparable models.

LA-511 LASER BEAM SENSOR.

Laser beam alignment is simple with on-board alignment monitor. Provides both analog and digital output. Class I type.

S-LINK SENSOR AND WIRE-SAVING LINK SYSTEM.

Operate up to 128 I/O devices on a 4-wire bus. Connects directly to all PLC brands.



To learn more about these SUNX products, please call **1-800-280-6933** for free literature.

Now, Our Quality Standards Are Beyond ComparISON.



Elmwood Sensors is pleased to announce that all Elmwood products have won the badge of ISO 9001 approval.

We've been setting global standards in customer service for years. Now, our high standards for quality are also being recognized internationally. Awarded for manufacturing consistency and quality, ISO 9001 certification represents the highest standards in the world.

But ISO 9001 represents more than world-class performance and global acceptance. It's a recognition of the consistent standards that have always distinguished Elmwood – standards of quality, reliability and customer service that are truly beyond comparison.



**Elmwood
Sensors**

Thermal Sensing and Control Technology... Worldwide.
500 Narragansett Park Drive • Pawtucket, RI 02861-4325, U.S.A.
Tel: 401-727-1300 • Fax: 401-728-5390

For More Information Write In No. 418

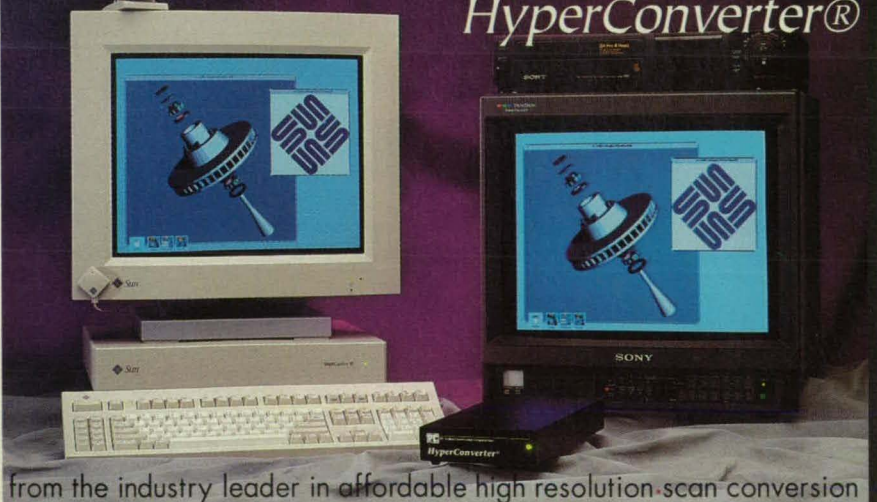
The channel patterns could take a variety of forms (see figure), depending on specific applications. The patterns would be chosen to maximize suppression of noise while minimizing aerodynamic loss. A liner containing acoustically dissipative channels could be constructed, for example, by stacking many cast plates in the required orientation(s) with respect to the wall of a duct. The plates could be straight or curved, smooth or rough, and dense or porous, depending on the application. The plates could be joined by any of a variety of methods, such as brazing, diffusion bonding, or using fasteners. The plate material would be selected to suit the noise to be suppressed as well as the velocity, temperature, and chemical species of the flowing gas. Some of the most desirable materials, although brittle, are readily cast into plates and thus are well suited to service in liners of this type.

*This work was done by Joseph Doychak of **Lewis Research Center** and Tony L. Parrot of **Langley Research Center**. For further information, **write in 36** on the TSP Request Card.*

This invention has been patented by NASA (U.S. Patent No. 5,250,764). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Lewis Research Center; (216) 433-5753. Refer to LEW-15430.

Videotape your high resolution computer graphics and animation with

HyperConverter®



from the industry leader in affordable high resolution scan conversion

HyperConverter1024...

from \$1395

input up to 1024 x 768 from
PC and Mac

HyperConverter1280...

from \$2995

input up to 1280 x 1024 from
PC, Mac, SUN, SGI, HP,
DEC, IBM, E&S

HyperConverter enables you to:

- Easily and economically record your high resolution computer graphics on professional and consumer video recorders
- Show your computer-generated presentations on large screen TVs and video projectors
- Produce broadcast quality composite (NTSC/PAL), Y/C (S-VHS) and component (RGB/YUV) video signals



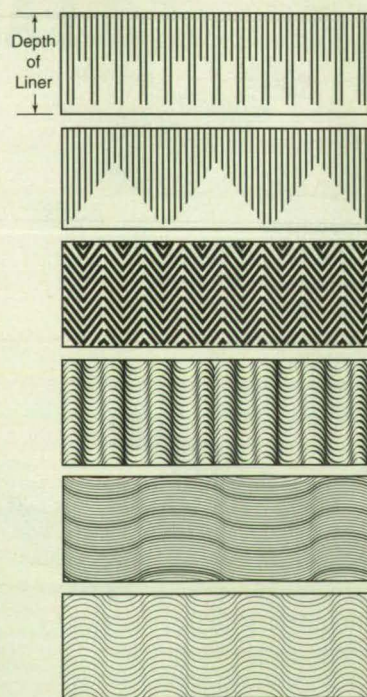
"For the price, there isn't anything else around that can touch the HyperConverter in performance or quality"

Charlie Reis Advanced Imaging Magazine November '93

PC PC Video Conversion

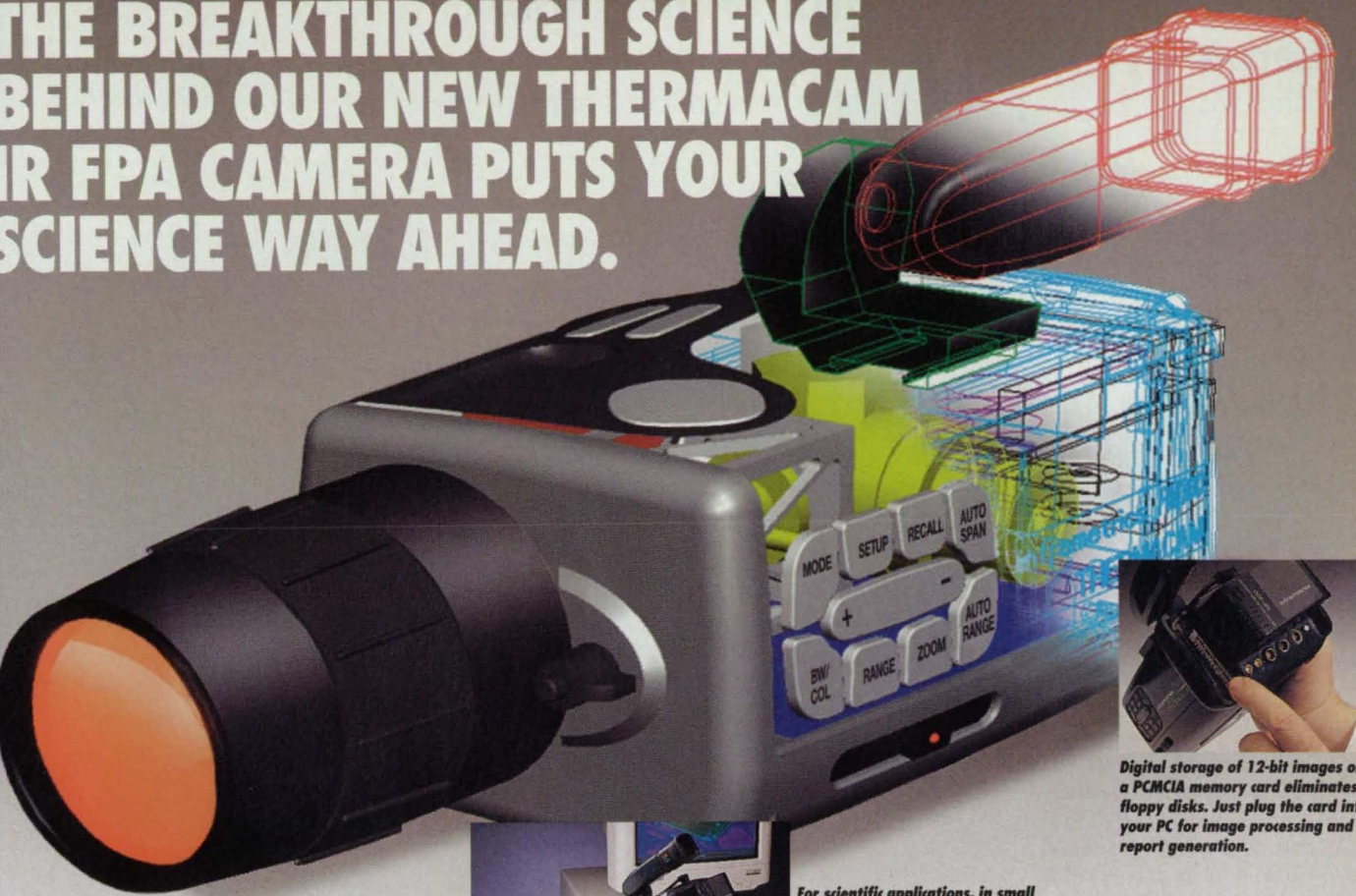
1340 Tully Road Suite 309 San Jose CA 95122 Tel 408.279.2442 Fax 408.279.6105

For More Information Write In No. 419



Shapes of Noise-Suppression Channels
could range from sharply angled linear patterns to gently undulating waves.

THE BREAKTHROUGH SCIENCE BEHIND OUR NEW THERMACAM IR FPA CAMERA PUTS YOUR SCIENCE WAY AHEAD.



Digital storage of 12-bit images on a PCMCIA memory card eliminates floppy disks. Just plug the card into your PC for image processing and report generation.



For scientific applications, in small test chambers and constricted settings, ThermoCAM's compactness simplifies experiment set-up.

What if you were designing breakthrough capability and convenience into R&D thermal analysis instrumentation? You'd probably create a totally portable, self-contained infrared imaging system. One with 256 x 256 pixel, full-screen temperature measurement, 12-bit dynamic range, and outstanding spatial resolution.

Well, consider it done. Inframetrics' ThermoCAM™ local plane array radiometer is a true performance and portability breakthrough. Weighing just six pounds complete with integral power source, ThermoCAM is the ideal solution for scientific applications.



And with just this rugged, palm-sized sensor, you can take full IR measurement and data storage capability into the field.

Engineering the world's smallest radiometer began with the smallest cryo-cooler, Inframetrics' patented Microcooler. Optimized electronics, custom ASICs, efficient diffractive optics, and a PCMCIA digital memory

card achieved breakthrough size and weight reduction. There's a full-color LCD display/viewfinder, plus remote and video links. And just 12 watts powers it all. Better still, Windows®-based ThermoGRAM image processing creates reports faster than you thought possible, right on your PC. Put ThermoCAM's science to work on your next breakthrough. Call Inframetrics today: (508) 670-5555.



inframetrics
The Infrared Specialists

Corporate Headquarters
16 Esquire Road
North Billerica, MA 01862
Tel: 508/670-5555
Fax: 508/667-2702

Inframetrics Europe
Mechelse Steenweg 277
B-1800 Belgium
Tel: 32 2 252 5712
Fax: 358 200 740 760 or
32 2 252 5388



ThermoCAM offers full screen temperature measurement and outstanding spatial resolution.

Adjustable-Length Strut Withstands Large Cyclic Loads

Threaded flanges apply preloads larger than could be applied by simple jam nuts.

Lewis Research Center, Cleveland, Ohio

An adjustable-length strut has been designed especially for installation in a structure in which it will be subjected to large cyclic loads. The strut partly resembles a large turnbuckle: it includes oppositely threaded eyebolts that engage correspondingly threaded holes at opposite ends of a shaft, and the shaft is turned to adjust the length. However, unlike in a turnbuckle, the length setting is not fixed by use of simple jam nuts: instead, the length setting is fixed by use of more complex threaded-end flanges that partly resemble jam nuts but function somewhat differently.

In the particular situation for which this adjustable-length strut was devised, it is impractical to use jam nuts to apply the large preloads needed to offset the anticipated cyclic loads. However, the threaded end flanges can be made to apply the necessary preloads, by use of moderate assembly torques.

The length of the strut is adjustable in a range of ± 1.25 in. (32 mm). Once the strut has been adjusted to the desired length, the threaded end flanges are turned to obtain a gap of 0.125 to 0.185 in. (3.2 to 4.7 mm). Then the six 1/2-in. (12.7-mm) bolts are inserted through clearance holes in each end flange to engage threaded holes in the end of the shaft. These bolts are tightened in a specified pattern, each to a final torque of 56 ± 5 lb-ft. (76 ± 7 N-m). At this torque level, the preload is sufficient to withstand tensile and compressive loads as great as 4×10^4 lb (1.8×10^5 N).

This work was done by Fred P. Carner of Rockwell International Corp. for Lewis Research Center. For further information, write in 88 on the TSP Request Card. LEW-15761

RevPoint 3D Systems Interactive 3D design

Affordable, real time 3D input is available right now. SoftWorld International has taken the best products from Europe and the United States and combined them in an affordable, intuitive package that you can use now.



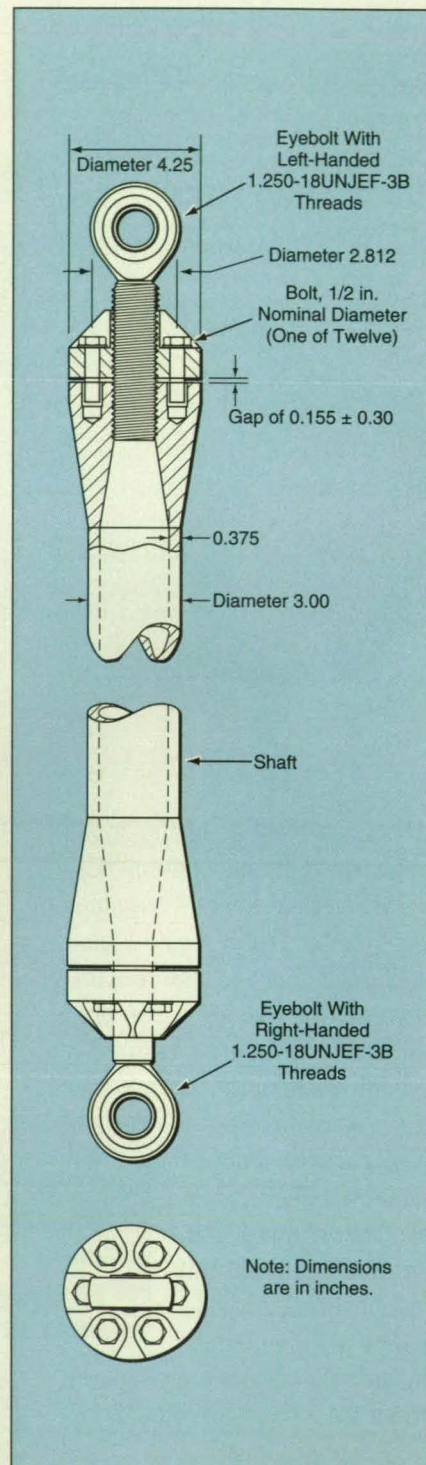
The RevPoint 3D Systems is a complete package that provides real time 3D input with all of the software you'll need for Reverse Engineering, Rapid Prototyping, 3D Modelling, or Design. As simply as you would use a tablet stylus, place the 3D probe on the surface of an existing part and you are now working in 3D.

- Hand held Flexibility
- Portable
- Stable, interactive input
- 0.005"/0,1 mm. resolution, 0.012"/0,3 mm. accuracy
- Low cost
- Easy to use real time input and commands

You'll be surprised at how affordable the RevPoint 3D System is. Call today for a free brochure and price list.

SoftWorld
INTERNATIONAL

The 3 Dimensional Solutions Company
133 admiral Street, Bridgeport, CT. 06601,
USA, Tel.: (203) 367-7789 Fax.: (203) 367-8331
European office: SoftWorld Aps.
Tel.: 45 45 41 00 77 Fax.: 45 42 42 03 88



This Adjustable-Length Strut can be highly preloaded to enable it to handle high cyclic tensile and compressive loads.

Tool Indicates Contact Angles in Bearing Raceways

Marshall Space Flight Center, Alabama

A tool has been devised for use in measuring contact angles between balls and races in previously operated ball bearings. The tool can be used on both inner and outer raceways of bearings that have cross-sectional widths between approximately 0.5 and 2.0 in. (12.7 and 50.8 mm). The tool consists of an integral protractor mounted in a vertical plane on a bracket equipped with leveling screws and a circular level indicator. The protractor includes a rotatable indicator needle and a set of disks of various sizes to fit various raceway curvatures. A disk with the radius of the raceway to be inspected is installed on the tool, and the tool is leveled on a flat surface. The tool is placed against the bearing raceway with the disk centered in the raceway. The indicator is rotated to the contact path marked on the raceway by the balls; this path indicates the contact angle to be measured, and the angle is simply read from the position of the indicator on the protractor scale. The measured angle can then be related to the load experienced by the bearing in service.

This work was done by Richard A. Akian and Myles F. Butner of Rockwell International Corp. for Marshall Space Flight Center. For further information, write in 14 on the TSP Request Card. MFS-30012

Gravity Slides With Magnetic Braking

These devices would enable safe emergency escape from tall buildings.

Marshall Space Flight Center, Alabama

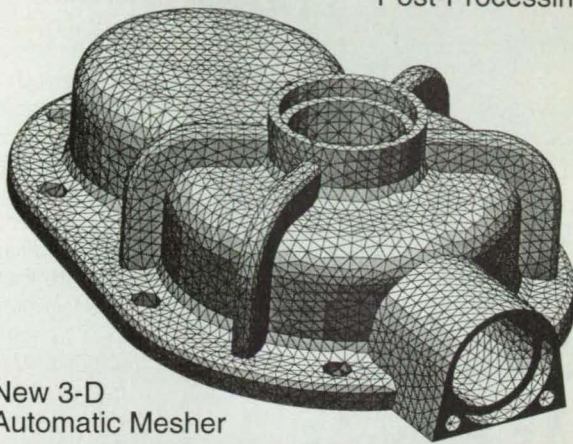
Slides with magnetic braking have been proposed to enable safe emergency descent from tall buildings, fire-truck ladders, towers, and the like. The basic physical phenomenon exploited by these devices is one that has been utilized for decades in automotive speedometers, dampers in meters, and coin sorters in vending machines: Sideways motion between a permanent magnet and a nearby nonferromagnetic metallic object induces an electrical current (eddy current) in the object; the eddy current, in turn, gives rise to a magnetic repulsion between the permanent magnet and the nonferromagnetic object. This repulsion consists of a force that tends to push the magnets away from the slide, plus a drag force that opposes the motion and can thus be used for braking.

The figure illustrates an example of an emergency slide according to this concept. The slide would include a sled that would move along a stationary aluminum track tilted against the top of a building. The sled would hold a set of permanent magnets at a preset small distance [typically 1/32 to 1/16 in. (0.8 to 1.6 mm) from the surface of the track]. A passenger would stand on, sit on, or be strapped to a platform on the sled. A release device at the top of the slide would hold the sled in place until the passenger was prepared for descent.

As the sled descended along the track, the magnets would induce electrical currents in the track. The currents and thus the drag force would increase with the speed of descent until equilibrium speed was reached; at this speed, the drag

FEMAP

Finite Element
Modeling and
Post-Processing



New 3-D
Automatic Mesher

Direct Interfaces with:

- AutoCAD R13
- AutoCAD Designer
- MicroStation Modeler
- Stereo-Lithography
- IGES, DXF

Available for:
Windows
Windows 95
Windows NT
and UNIX

Supports Twenty Finite Element Analysis Programs

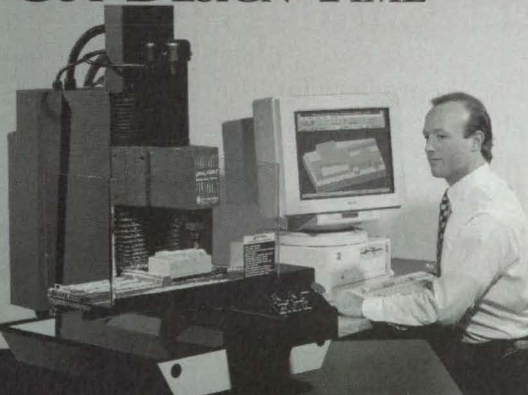
ENTERPRISE SOFTWARE PRODUCTS, INC.

610-594-2454 • 610-594-7579 FAX • femap@pond.com E-Mail

FEMAP ADVANCED MESHING MODULE utilizes ACIS software by SPATIAL TECHNOLOGY INC.
All Product Names are Trademarks or Registered Trademarks of their respective owners.

For More Information Write In No. 421

Our rapid prototyping
systems let you . . .
CUT DESIGN TIME



AND CUT COSTS.

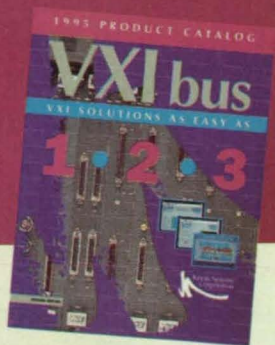
- Makes 3-D prototypes and parts
- Works with your CAD/CAM software
- Cut your choice of materials, including steel

1-800-221-2763



**LIGHT MACHINES
CORPORATION**

444 East Industrial Park Drive
Manchester, New Hampshire 03109-5317
(603)625-8600 FAX 603.625.2137 800/221-2763
email: info@lmcorp.com



VXI Solutions As Easy As...

1 By Phone or E-Mail.
Call 1-800-DATA-NOW
(1-800-328-2669)
E-Mail: SALES@KSCORP.COM
Outside USA: (815) 838-0005

2 On disk.
Our new catalog is also available on a Windows compatible floppy disk, with complete instructions.

3 On the Internet.
Find our catalog at
<http://www.kscorp.com>

With Our FREE Catalog!

- **NEW** VXI products for high performance data acquisition
- **NEW** software and drivers
- **NEW** connection configurations
- **NEW** application examples
- **NEW** services



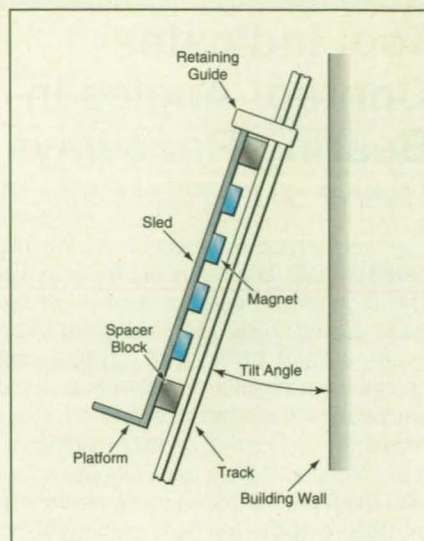
Building System Solutions...Together.

900 N. State St. • Lockport, IL 60441

would equal the gravitational force pulling the sled down the track, and thus the speed would not increase beyond this value.

For a given passenger weight, the equilibrium speed would depend on several factors, including the properties of the magnets, the electrical conductivity of the slide, and the distance between the magnets and the track. For example, preliminary calculations and experiments with a scale model indicate that a slide could be designed to enable a passenger who weighs 250 lb (113 kg) to descend at a speed of about 8 ft/s (2.4 m/s). Corrosion of the track would not hinder operation of the slide as long as the electrical conductivity and thickness of the track were not altered significantly.

This work was done by Thomas F. Goodrick of **Marshall Space Flight Center**. For further information, **write in 21** on the TSP Request Card. MFS-31072



The **Sled** Would Descend Along the Track, its motion retarded by magnetic drag. The retaining guide would limit any lateral movement of the top of the platform away from the slide, and would keep the slide in place for inclination angles of 30° to 40°. At tilt angles of less than about 30°, additional retaining guides would be needed.

High-Torque, Lightweight, Pneumatically Driven Wrench for Small Spaces

John F. Kennedy Space Center, Florida

A pneumatically driven wrench can provide torque up to 3,000 lb·ft. (≈4 kN·m) in a small space. The head is designed to reach into a 2.6 × 2.75 × 6 in. (6.6 × 7.0 × 15.2 cm) pocket. The wrench weighs approximately 25 lbs (11.4 kg). The torque wrench includes a reversible pneumatic motor (an electric motor could be used instead) and a slip

clutch. The wrench also includes a device that indicates the total angle through which the wrench has turned a bolt or nut. This feature can be used for a turn-of-the-nut tightening method.

This work was done by Thomas W. Miller of **Kennedy Space Center**. For further information, **write in 20** on the TSP Request Card. KSC-11731

Device for Testing Compatibility of an O-Ring

Lyndon B. Johnson Space Center, Houston, Texas

A fixture has been designed for use in exposing a compressed elastomeric O-ring or other ring seal to a test fluid. The fixture can be made of metal or plastic, with a threaded recess into which an O-ring can be placed. Opposite the threaded end is an opening through which a test fluid can be introduced and placed in contact with the O-ring. After exposure, the compression set and swell or shrinkage of the ring can be measured. The fixture can

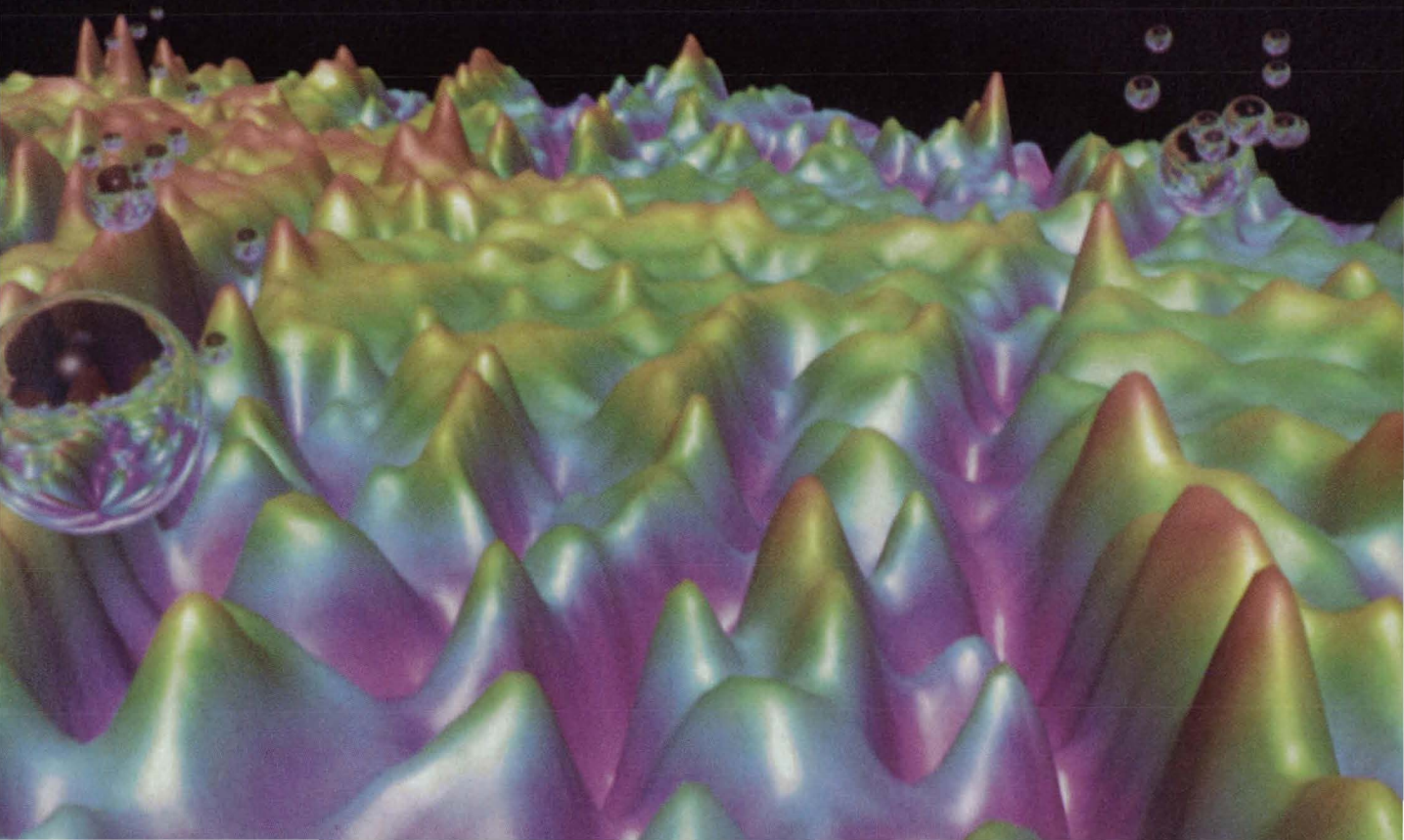
be set to compress the ring by a selected amount (usually, 25 percent), providing for reproducible compression.

This work was done by Dennis D. Davis of **Lockheed Engineering and Sciences Co.** for **Johnson Space Center**. For further information, **write in 66** on the TSP Request Card. MSC-22504

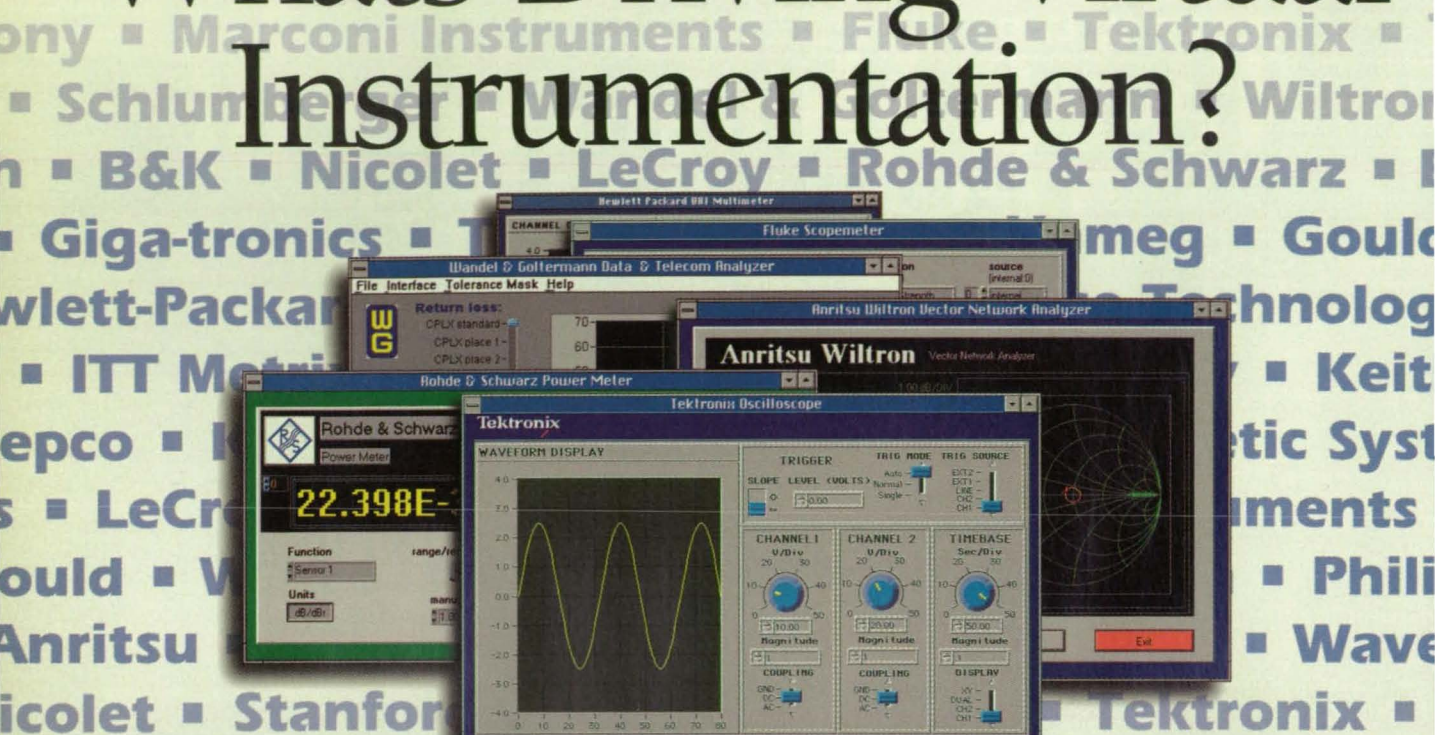
FEDERAL LAB

Test & Measurement

TECH BRIEFS



What's Driving Virtual Instrumentation?



Instrument Drivers.

From LabWindows®/CVI and LabVIEW®

Virtual instrumentation is making "open systems" a reality. Today, engineers are integrating multivendor instruments in cost-effective PC-based test systems. Instrument drivers – software modules with which you can easily control your instruments – are driving the success of open system development. When you choose LabVIEW or LabWindows/CVI, you're aligning with the driving force behind virtual instrumentation – an open instrument driver technology that makes multivendor systems a reality.

Intuitive Instrument Control

With an instrument driver, tedious instrument programming tasks are replaced with simple, easy-to-use functions for configuring and controlling instruments. Instrument driver functions handle instrument command syntax, I/O communications, and data conversion, so you'll be up and running in minutes. Plus, every LabVIEW and LabWindows/CVI instrument driver is delivered in source code, so you have

the flexibility to optimize each driver to fit your own particular application.



Industry-Wide Acceptance

LabWindows/CVI and LabVIEW have instrument driver libraries of more than 450 instruments from more than 45 instrument vendors – so you can easily modernize your installed base of instruments. And, you'll be aligned with an industry standard. In the VXI world, where emerging software standards ensure true interoperability, the VXIplug&play Systems Alliance endorsed LabVIEW and LabWindows/CVI instrument drivers as core technologies for industry standardization.

Cut your instrument programming time in half with LabWindows/CVI and LabVIEW. For a **FREE** demonstration package, call **(800) 433-3488**. (U.S. and Canada)



NATIONAL INSTRUMENTS™
The Software is the Instrument®

Corporate Headquarters: Tel: (512) 794-0100 • Fax: (512) 794-8411 • E-mail: info@natinst.com • WWW: <http://www.natinst.com>

Branch Offices: Australia 03 9 879 9422 • Austria 0662 45 79 90 0 • Belgium 02 757 00 20 • Canada 519 622 9310 • Denmark 45 76 26 00
Finland 90 527 2321 • France 1 48 14 24 24 • Germany 089 741 31 30 • Hong Kong 2645 3186 • Italy 02 48301892 • Japan 03 5472 2970 • Korea 02 596 7456
Mexico 95 800 010 0793 • Netherlands 0348 433466 • Norway 32 84 84 00 • Singapore 2265886 • Spain 91 640 0085 • Sweden 08 730 49 70
Switzerland 056 200 51 51 • Taiwan 02 377 1200 • U.K. 01635 523545

© Copyright 1995 National Instruments Corporation. All rights reserved. Product and company names listed are trademarks or trade names of their respective companies.

Ask about our Windows® 95 32-bit software

For More Information Write In No. 450

CONTENTS

Federal Lab Test & Measurement Tech Briefs

Supplement to *NASA Tech Briefs* November 1995 Issue

Published by Associated Business Publications in cooperation with the Federal Laboratory Consortium for Technology Transfer

FEATURE

- 2a Field Capture System: a Test Dilemma Solved

TEST & MEASUREMENT TECH BRIEFS

- 4a Direct Flu Detection Using Molecular Arrays
- 6a Calibrating Polarimetric Radar with Only Natural Targets
- 7a Octapod Streamlines Surveys of the Earth's Subsurface
- 8a Revolving Eddy-Current Probe Detects Cracks Near Rivets
- 9a A Bioassay for Assessing Marine Contamination
- 10a Spectroscopic Measurement of Temperature and Pressure of O₂
- 10a Digital Image Analysis of Coloration in Dyed Textiles
- 13a Using Ultrasonic Lamb Waves to Measure Moduli of Composites
- 14a A Portable Surface Inspection System
- 14a Measuring Traces of Oxygen by Resonant Electron Attachment
- 17a Double-Knudsen-Cell Apparatus Measures Alloy-Component Activities
- 18a Flexseal Insulator Test Assembly

Books & Reports

- 19a Further Study of Face Gears for Helicopter Transmissions
- 19a Research in Diagnosing Bearing Defects from Vibrations
- 19a Microchemical Analysis of Space Operation Debris
- 19a Experiments on No-Vent Filling of a Tank with Liquid H₂
- 20a Molecular Beam to Simulate Impinging Rocket Exhaust
- 20a Predictions of Accretion of Ice on a Commercial Airplane
- 20a Determination of LETs of SRAMs by Use of a Laser
- 20a Laser-Based Instrument Measures Propagation of Cracks
- 20a Temperature and Density Measurements Using O₂ Fluorescence
- 21a Experiments on Vibration-Induced Loosening of Bolts
- 21a Study of Tracing of Airflow with Neutrally Buoyant Bubbles
- 21a Study of Partial-Band Detection of Frequency-Hopped Signals
- 21a Hazardous Fluids Compatibility Test Apparatus

On the cover:

The image, representing a portion of the ocean floor near Antarctica, was generated at the San Diego Supercomputer Center (SDSC) by creating a 3D surface plot from gravity measurements obtained by satellite, with color interpolation applied to chrominance values assigned to each vertex. Image generated by Jim McLeod of the SDSC, and C. Small and David Sandwell of Scripps Institution of Oceanography. *Photograph courtesy San Diego Supercomputer Center.*

UN 411E. Another brilliant ELMO technological advance!

Digital signal processing micro camera, less than 1/3 of an ounce, delivers over 470 TV (H) resolution. 1-1/2" (36mm) long including lens, 1/2" dia. (12mm). Delivers broadcast quality. Perfect for limited space applications. Auto and manual electronic shuttering from 1/60s to 1/10,000s, YC terminal, choice of 7 lenses including macro for robotics, machine vision and medical use. Internal / External sync (genlock). Fantastic!

SEE MORE CLEARLY NOW!

TSN 400. See the difference!

Crisp 470 TV (H) resolution at 2.2 lux. Available in 24VAC, 12VDC and 120VAC. Only 2.4" x 2.4" x 3.1". All controls located on the outside of the camera for fast, easy accessibility. Controls include back focus adjustment wheel, V phase, sens up, auto white balance, auto and manual electronic shuttering to 1/10,000s. The 12VDC model has YC and composite video outputs. Remarkable!

See more clearly with Elmo high res CCD cameras. Call Elmo and talk to a "live" person, never a recorded message. You'll enjoy prompt answers and support from people who know CCD cameras.

For more information, call 1-800-947-ELMO.

ELMO Mfg.
Corp.

70 New Hyde Park Road, New Hyde Park, NY 11040 • Tel: 1(516)775-3200 • Fax: 1(516)775-3297
21720 Nordhoff St., Chatsworth, CA 91311 • 1(818)346-4500 • 44 West Dr., Brampton, Ontario, Canada L6T 3T6 • 1(905)453-7880

Field Capture System

A Test Dilemma Solved

In a testing organization, the distribution of test data in a timely manner is as important as achieving the test objectives. The end users, normally decision-makers, technical analysts, and government contractors, often need access to the data immediately after a test event.

The Field Command of the Defense Nuclear Agency (FCDNA) generates a variety of data and information such as Test Support Plans (TSPs), blueprints of test beds, instrumentation layout and descriptions, predictions and post-test execution, preliminary results, Project Officer Reports (PORs), waveform data, photographs, and video.

One major challenge in analysis has been the wide variety of test data formats. TSPs, PORs, and test planning documents are normally provided as published hard-copy items. Blueprints are generally available in poster-board-size sheets. Motion pictures are provided in various formats of video as well as 16-mm film. Still photos are available in various sizes. Waveform data is typically provided on computer floppy discs. This variety of data formats made it extremely difficult and expensive in the past to provide test data to the large number of customers involved with a typical DNA test.

To provide a more efficient and cost-effective method of test measurement and evaluation, DNA developed the Field Capture System (FCS) through a contract with Horizons Technology Inc. of San Diego, CA. The FCS correlates all of the various inputs related to each testing situation and produces a complete CD-ROM with all of the information archived for rapid retrieval, distribution, and evaluation via personal computer. Horizons is poised to move the system into the commercial market.

DNA Field Command is currently operating a FCS at its facility in Albuquerque, NM. The system captures all of the varied inputs from a series of conventional weapons tests, and stores them in digital format on a CD-ROM that can be used for review, analysis, and historical purposes.

A major feature is the system's ability

to digitize video and include high-quality images on the CD for playback on the computer. Because the video is in digital format, it provides the viewer with great flexibility in retrieval and analysis of specific events.

Another major advantage of the FCS is that information is labelled and archived immediately as part of the process, rather than having a separate organization responsible for the archiving. This not only saves time and money, but also provides a complete and authentic record of the event.



(Above) Program manager David King makes final checks to the Field Capture System, used to instantly analyze and archive munitions effects by capturing video (shown on right screen) and other inputs on a CD-ROM for computer playback (left screen). (Above left) A typical screen capture of the Field Capture System.

Each CD-ROM produced includes:

- an index of related test events and data;
- the viewer software, designed for MS Windows;
- an automatic installation program; and
- the data.

Thus, virtually any PC system configured for Windows 3.1 or better with a CD-ROM drive (2X or better) is capable of retrieving and viewing the data. The viewer utilizes commercial off-the-shelf software for plotting, word processing, CAD and spreadsheet analysis. As multiple CD-ROMs are produced, the master index is updated, thereby creating a library of data for one or more events.

For data capture, the FCS includes a color scanner with optical character recognition software for imaging documents, photos, drawings, etc. A tape deck and monitor are used in conjunction with capture and compression software to produce digital video. Data

already in digital form, such as waveforms, can easily be copied to the FCS. Multiple copies of the output CD can be made for rapid distribution to all those interested in the test results.

Horizons Technology sees great commercial potential for the FCS where a vast amount of data needs to be collected, organized, and correlated. Some of the applications are:

- Law enforcement: Video of crime scenes is being much more widely used, and can be easily integrated with all of the other information relating to a case;

- Construction: Video documentation of large construction sites can be correlated with drawings, progress reports, soil samples, and so forth. Such documents would be valuable for quality control and for any possible future litigation;

- Medical services: Combining new video-based diagnostic techniques with lab studies and doctors' reports can make the evaluation of many diverse pieces of information much more efficient;

- Laboratories: Test results combined with graphs,

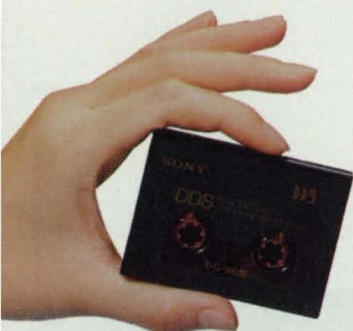
charts, video, and so forth provide a complete, permanent record of work performed;

- Environmental control: Documenting site surveys and cleanups, along with budgeting and other administrative details, can be efficiently accomplished;

- Insurance: Claim reports and investigations can include video, audio, photographs, drawings, maps, and so forth to provide a complete, permanent record of each incident.

For additional details, contact Program Manager Major Greg Fritz, Headquarters, Defense Nuclear Agency, Test Requirements Division, 6801 Telegraph Road, Alexandria, VA 22310; (703) 325-8385. The FCS in Albuquerque is operated by Janet King, Field Command, Defense Nuclear Agency. Additional information can also be obtained from Bill Lee, Horizons Technology, 3990 Ruffin Rd., San Diego, CA 92123-1826; (619) 292-8331; FAX (619) 292-7321.

This is the world's most advanced data recorder.



And dat's DAT.

Less is more.

The Sony PC200 Series is an entire new generation of data recorders. The smallest go-anywhere recorders available. With features and performance that put them in a class by themselves. And with configurations from 2 to 64 channels, bandwidths from DC to 100 KHz, and even a hybrid for simultaneous wideband analog and/or digital data, there's a model to precisely fit your requirements.

The DAT advantage.

Sony pioneered DAT, and we know how to get the most out of it. The new PC200 Series can record up to 6 hours of data with an overall transfer rate of up to 3.072 Mbps. Good data, with a signal to noise ratio greater than 82dB. Nothing else comes close.

The ins and outs.

Since small size enhances portability, Sony provides an RS232 for onsite remote control via laptop, palmtop, your choice. Going the other way, the SCSI IF500 interface provides optimum data transfer to your PC or workstation. Because the faster your data becomes information, the better.

The soft stuff.

Imbedded in every PC200 Series recorder is Table of Contents software utilizing the first two minutes of tape to summarize its contents for fast and easy searches on the computer. You can write each recording block's sub data such as ID, ADDRESS, and RANGE. Even TIME CODE. And, with Sony's powerful PCscan™ data acquisition software, turning your data into information was never easier.

The Sony advantage.

Of course, when you choose the PC200 Series data recorders, you choose Sony, and you know what that means in terms of constant technology advancement and leadership, rugged reliability, and full support. Only Sony could make data recording exciting. Give us a call and we'll tell you just how exciting it gets. All DAT and more.

SONY®

Sony Magnescale America, Inc.

137 West Bristol Lane • Orange, CA 92665
(714) 921-0630 • FAX (714) 921-1162

Sony is a registered trademark of Sony Corporation

Test & Measurement

TECH BRIEFS

Direct Flu Detection Using Molecular Arrays

A new technique detects pathogens and has potential to detect toxins and pollutants, and screen engineered drugs.

Lawrence Berkeley Laboratory, Berkeley, California

Researchers at Lawrence Berkeley Laboratory (LBL) have devised new techniques for diagnosis and potential treatment of influenza virus infections using molecular arrays constructed to mimic influenza virus binding sites on the cell surface. In addition to the influenza virus, LBL's method can potentially detect a wide variety of pathogens and other organisms or molecules with known binding sites.

For diagnostic purposes, LBL researchers have constructed a self-assembled monomolecular film that is able simultaneously to detect and report back on specific binding of physiologically significant concentrations of influenza virus. The report is presented as a rapid change in the color of the film, which turns from blue to red when virus particles bind and disrupt its ordered matrix. The color change can be monitored visually for presence or absence of the virus, or quantified simply and inexpensively using a colorimeter. This direct detector system saves time, money, and unnecessary complexity in comparison with virus detection based on cell culture assays, which require lengthy incubation periods in expensive facilities.

LBL researchers have also constructed polymerized liposomes—hollow spheres of self-assembled lipids—that are covalently bonded to multiple copies of analogs of the influenza virus binding ligand. Virus particles bind irreversibly to the binding ligand analogs on the liposome surface. Polymerized liposomes prepared using this new LBL technique have shown themselves to be extremely potent inhibitors of *in vitro* influenza virus infectivity. Such liposome preparations may provide a basis for new materials that act as therapeutic agents for treatment of influenza as well as other diseases, and should also serve as an important model in understanding pathogen-cell interactions.



Lawrence Berkeley Laboratory scientists use a new apparatus to assemble monomolecular films that detect viruses and other infectious disease agents.

Among the diagnostic technique's advantages are that it requires only minutes of an untrained user's time, compared with hours or days of lab staff time; that it is interpretable in either qualitative (presence/absence) or simple quantitative terms, by using readily available colorimeters; that it uses cellular

binding sites common to all strains of influenza virus rather than variable antigen/antibody reactions as the diagnostic; and that it detects virus at a fraction of the concentration typically associated with symptoms.

Potential applications include detection of other pathogens such as viruses,



\$1,700-3,000

Portable Calibrators DC Voltage - Current - Temperature

- ± 22 Volt range, 10 nV resolution, 10 ppm accuracy.
- ± 22 mA range, 10 pA resolution, 40 ppm accuracy.
- Temperature measurement and simulation.
- Thermocouple types B, E, J, K, N, R, S and T.
- 0.01 °C/F resolution, 0.03°-0.06°C accuracy.

For More Information Write in No. 452

Portable Power Analyzer

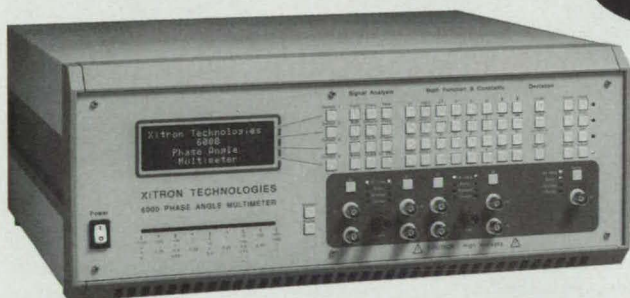
- 0.1 % accuracy up to 10 KHz, 0.5 % at 100 KHz.
- 600 V/20 A rms input ranges and external current shunt.
- Operates up to 2 hours on rechargeable batteries.
- Measures watts, VA, VAR, power factor, phase, and signal frequency. Optional IEEE-488/RS-232 interface.

For More Information Write in No. 453

\$1,995



from \$9,995



Phase Angle Multimeter

- 0.05° phase accuracy.
- 0.05 % amplitude accuracy.
- Harmonic and wideband analysis to 100 KHz.
- Portable version also available.

For More Information Write in No. 454

**IEC 555
Testing**

1, 2 and 3 Phase Power Analyzers

- 0.05 % amplitude accuracy.
- 0.05 % current accuracy.
- Input ranges from 15-1200 V rms for frequencies from DC to 500 KHz.
- Internal current ranges from 50 mA-40 A rms, and external shunt or CT input.
- Measures Watts, VA, VAR, V, A, PF, CF, K factor, form factor, THD, harmonics and flicker per IEC555, RMS/peak/average/inrush values, Triplens, efficiency, loss, load impedance, WHr, battery charge/discharge, frequency, phase etc. Optional analog I/O capability.

For More Information Write in No. 455



XITRON
TECHNOLOGIES

Xitron Technologies Incorporated
6295 Ferris Square, Building D
San Diego, California 92121

Tel: (619) 458-9852
Fax: (619) 458-9213

bacteria, malaria parasites, and proteins, both in laboratories and home tests; detection of industrial enzymes and other proteins; screening of new drugs; and development of therapeutic agents for treatment of viral, parasitic, and bacterial infections.

This work was done by Deborah Charych, Jon Nagy, Wayne Spevak, and Mark Bednarski at **Lawrence Berkeley Laboratory**. Patents are pending, licensing is available, and the Laboratory is seeking industrial partners for develop-

ment. For further information contact LBL, Technology Transfer Department, 1 Cyclotron Road, M/S 90 1070, Berkeley, CA 94720; (510) 486 6467; FAX (510) 486-6457.

Calibrating Polarimetric Radar With Only Natural Targets

The calibration algorithm is based on known scattering properties.

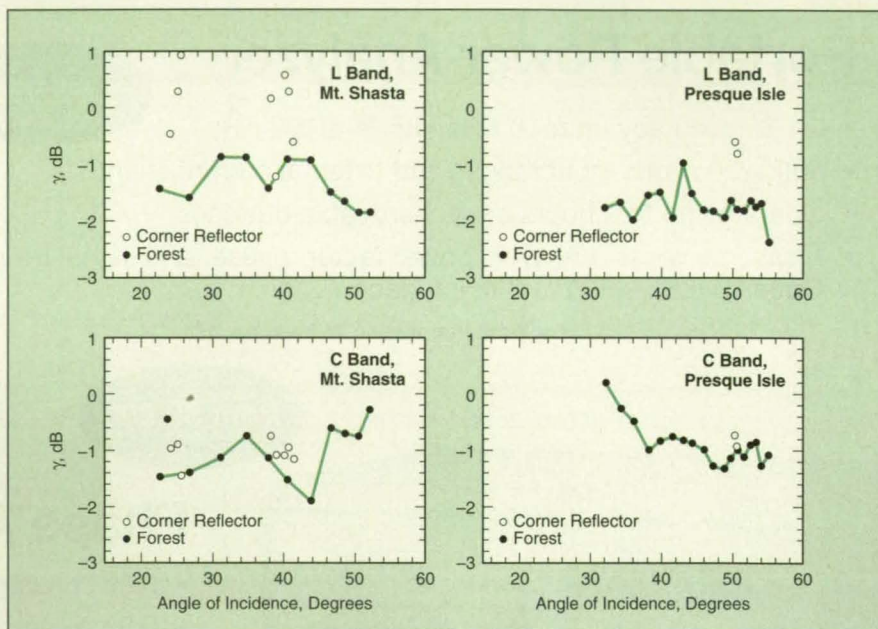
NASA's Jet Propulsion Laboratory, Pasadena, California

A method of calibrating polarimetric radar images involves the use of natural, distributed targets only; that is, there is no need to place artificial point calibration targets like corner-cube reflectors in the target scene. The method is based on a few simplifying mathematical assumptions that are, in turn, based on known electromagnetic-scattering characteristics of natural targets.

Accurate calibration is essential for the use of polarimetric radar data gathered in remote sensing of terrain. Heretofore, artificial point targets have been used; typically, this has involved great difficulty, especially when it has been necessary to place such targets in harsh environments. In addition, the iterative computations of older methods of calibration based on distributed targets have frequently failed to converge or have taken excessive time. Some older methods of calibration are based partly on the assumption that crosstalk parameters are small. The present method does not depend on this assumption, is computationally efficient, and always yields convergence.

The method provides a step-by-step procedure for the determination of six unknown complex calibration parameters. The basic equations of the method are derived in a matrix formulation that provides a compact representation of the electromagnetic-scattering characteristics of the target and the gain, crosstalk, and other parameters of the radar equipment. The assumption that the target is reciprocal (with respect to electromagnetic scattering) is incorporated into this formulation. On the basis of this reciprocity, the measured scattering matrix is symmetrized and the number of unknowns is reduced to three. These unknowns are two crosstalk parameters and one channel-imbalance parameter.

It is further assumed that the natural distributed target exhibits reflection symmetry with respect to the incidence plane, which contains the radar wave incidence direction and the normal direction of surface above distributed targets. For natural targets, which are



These **Plots of Copolarization Ratio, γ** , of forests and corner-cube reflectors contain data used in amplitude calibration. The data show that, among other things, amplitude imbalance between the horizontal and vertical polarization channels can be corrected to less than 0.5 dB if forests are used to estimate this imbalance.

reflection-symmetric to the incidence plane, the statistical distribution of position, shape, and orientation of scatterers constituting the target is symmetric with respect to this plane. This assumption is valid for most natural distributed targets. The method incorporates a novel algorithm that estimates the crosstalk parameters by use of equations that exploit reflection symmetry. The effect of crosstalk can then be removed from the radar image. The foregoing symmetrization of data and removal of crosstalk can be performed on almost any set of polarimetric radar image data.

Next, the phase and amplitude of the channel imbalance are determined by use of distributed targets that exhibit rotation symmetry or by use of volume and surface targets that provide known phase and amplitude relations between the radar responses obtained while using (1) horizontal polarization in both transmission and reception and (2) vertical polarization in both transmission and reception.

This method has been applied to synthetic-aperture radar images of ice on the Beaufort sea (no corner-cube reflectors in the scene), forest near Mt. Shasta in northern California (with corner-cube reflectors) and forest on Presque Isle in Maine (with corner-cube reflectors). In the two scenes in which corner-cube reflectors were available, their radar signatures were analyzed to verify the calibration by this method (see figure). When the method was applied to the sea-ice images, the extracted crosstalk parameters were found to agree very well with those obtained from the forest images, indicating that both sea ice and forests are good candidates for polarimetric calibration.

This work was done by Simon H. Yueh, Son V. Nghiem, and Ronald Kwok of Caltech for **NASA's Jet Propulsion Laboratory**. For further information, write in 16 on the TSP Request Card. NPO-19192

Octapod Streamlines Surveys of the Earth's Subsurface

A rugged, nearly maintenance-free instrument can be operated by a single person.

Argonne National Laboratory, Argonne, Illinois

Electromagnetic (EM) surveying and direct-current earth resistivity surveying are geophysical methods used to study earth materials for subsurface groundwater and environmental studies and engineering purposes. EM surveys measure the electromagnetic properties of the earth, and resistivity surveys measure its electrical resistance. The EM surveying techniques are rapidly replacing resistivity surveying methods because the former are less labor intensive, time-consuming, and costly. The EM techniques developed for rapid data acquisition in airborne mineral exploration are effective except in areas subject to intense radio-frequency transmissions.

To overcome current limitations in both EM and resistivity surveying, Argonne National Laboratory constructed an electrode array called the "Octapod." Used in horizontal ground resistivity applications, it eliminates a cumbersome, time-consuming procedure commonly needed in this type of geophysical surveying. In traditional horizontal surveying, four conducting electrodes—two potential and two current—are arranged in a linear pattern. Surveyors must hand-carry these electrodes and drive them into the ground at places targeted for study of the earth's electrical properties.

To stabilize the array as it is carried and to decrease electrode-to-ground resistance, Argonne devised a paired electrode system in which four current electrodes—two left and two right—are fixed at the two ends of the array, and four potential electrodes are spaced—two left and two right—in a symmetrical pattern between the four current electrodes. The distance between the left and right electrodes can be varied as needed.

The electrodes are steel or aluminum dishes sized to permit towing over uneven terrain while keeping them in contact with the ground. The coupling between the dishes and ground is enhanced with water, as required. Gravity allows the water to drain through a flexible plumbing system connected to the dishes. The electrical coupling between electrodes and ground is further enhanced with copper-coated steel grounding rods inserted through a conductive metal shaft attached to the center of the dish electrodes. Surveyors can determine resistivity by connecting the array

to any standard resistivity meter, a device that simultaneously measures current and voltage.

A switch box added to the array allows surveyors to make resistivity readings in several modes: using electrodes only on the left side, only on the right, or

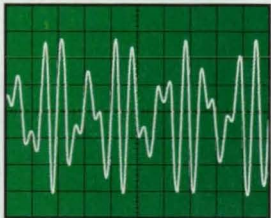
on both sides of the Octapod. Using both the left and right electrodes connected in parallel halves the contact resistance between electrodes and ground and results in a mean apparent resistivity beneath the array.

The Octapod has undergone field

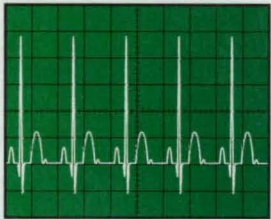
Three Lab Sources



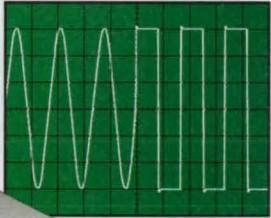
ONLY \$2695



100MSa/s ARB Generator
With 99 waveforms, 64k memory and IEEE 488.2 interface, your custom waveshape needs are fulfilled.



Sequence Generator
Total of 9 sequences can link 99 waveforms and loop each one up to 32768 times.



50 MHz Sine/Square
Function generator includes triangle, pulse, ramp, sinc, Gaussian, exponential and dc.

In One Box

The Pragmatic 2416A synthesized Function/ARB/Sequence Generator offers performance and economy.

For immediate support call 1-800-PRAGMATIC.

PRAGMATIC
INSTRUMENTS, INC.

7313 Carroll Road, San Diego, CA 92121-2319
Tel. (619) 271-6770 • Fax. (619) 271-9567

**WaveCAD
Creation
Software
Available**

testing at Aberdeen Proving Ground, Maryland, and has proved to be robust, field-worthy, and nearly maintenance-free. Only one person is needed to operate the Octapod. Repeat observations can be made in several tens of seconds

instead of in the 5-10 minutes required by conventional surveying techniques.

This work was done at **Argonne National Laboratory**. Companies interested in licensing and/or cooperative research and development opportunities

are encouraged to mail or FAX a letter of interest to Octapod, Industrial Technology Development Center, ITD-900, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439; FAX (708) 252-5230.

Revolving Eddy-Current Probe Detects Cracks Near Rivets

A circular scanning pattern reduces the interfering effects of the rivets themselves.

Langley Research Center, Hampton, Virginia

Scanning an eddy-current probe in a circular pattern has been found to increase the sensitivity with which the probe indicates fatigue cracks and other defects in metal surfaces in the vicinity of rivets. The technique was devised to facilitate the inspection of riveted joints in aircraft.

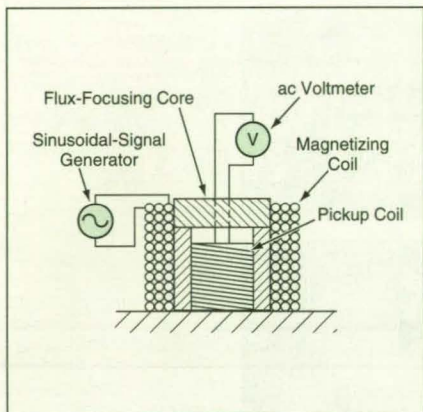


Figure 1. This **Self-Nulling Eddy-Current Probe** is used to detect subsurface flaws in riveted joints.

The eddy-current probe in question (see Figure 1) was described in "Electromagnetic Flaw Detector Is Easier To Use" (LAR-15046), *NASA Tech Briefs*, Vol. 18, No. 7 (July, 1994), page 36. In operation, the magnetizing coil is excited with a sinusoidal waveform and the probe is laid flat on the surface of the metal plate or sheet to be inspected. As explained in more detail in that article, the voltage induced in the pickup coil is close to zero when the probe is placed on or sufficiently close to a metal plate or sheet that contains no defects, but rises from zero when a defect in the vicinity of the probe interrupts the electrical continuity of the plate or sheet and thereby diverts some of the eddy current into the area under the pickup coil. Thus, the probe is self-nulling and pro-

vides a simple, easy-to-interpret output indicative of defects.

Previously, it was observed that when the probe is scanned over a riveted joint, the discontinuity of the rivet itself causes some of the eddy current to flow under the pickup coil, giving rise to an output voltage that does not signify a defect but is large enough to mask the signal from a small defect located close to the shank of the rivet. The circular-scan technique was developed to reduce the interfering effect of the rivet. The technique is based on the observation that when the probe is held flat against the surface and moved around the rivet at a constant radius, the component of the output signal attributable to the rivet remains more nearly constant than it otherwise would as the angular position of the probe

varies. Thus, any further increase in the output signal as a function of angular position is more likely to signify a defect (see Figure 2).

This work was done by Min Namkung of **Langley Research Center**; Buzz Wincheski, James P. Fulton, and Shridhar Nath of *Analytical Services and Materials, Inc.*; and John Simpson of *Lockheed Engineering and Sciences Co.* For further information, **write in 4** on the TSP Request Card.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center; (804) 864-3521. Refer to LAR-15231.

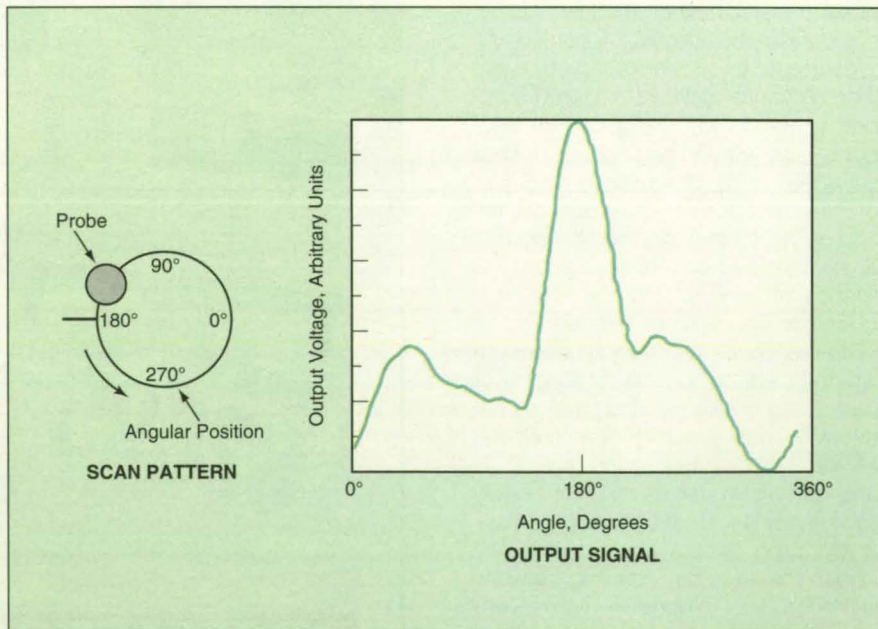


Figure 2. The **Output Voltage** of the probe, measured as a function of angular position during a circular scan around a riveted joint, includes a component contributed by a notch introduced at the 180° position to simulate a defect. The notch, made by electrical-discharge machining, extended out to 0.3 mm beyond a rivet head 8 mm in diameter.

A Bioassay for Assessing Marine Contamination

Bioluminescence helps determine whether a targeted area needs remediation.

Naval Command, Control and Ocean Surveillance Center (NCCOSC), San Diego, California

It has become increasingly important to be able to quickly assess the toxic content of test samples with confidence, ease, and success. The dispersion of metals, effluents, discharges, and paints into the earth's natural waters presents an immediate need to evaluate sublethal acute, acute, and chronic effects on marine organisms.

The Qwiklite bioassay, developed by the laboratory at NCCOSC, is used as a biological tool to gauge the extent of environmental contamination. Some species of marine phytoplankton have the ability to produce bioluminescence, a visible blue light, as part of their daily physiological process. The ecological role these minute organisms play as primary producers in the ocean makes them ideal subjects and biological tools in many laboratory situations.

The Qwiklite bioassay determines acute response and chronic effects of a wide variety of toxicants upon bioluminescent dinoflagellates by measuring their light output after exposure. Successful bioassays of this type have been performed on the bioluminescent dinoflagellate *Gonyaulax polyedra*. The use of bioluminescent dinoflagellates, as part of a broader-based biological and chemical testing program, can help identify a potential problem.

Sea water and appropriate amounts of toxicants are mixed and distributed into optical-grade spectrophotometric plastic cuvettes. Dinoflagellate cells are added to produce a concentration of about 300 cells per cuvette (3 ml). Cells are kept in the dark to allow for dark phase optimization (maximum bioluminescent potential) prior to testing.

When sampling for a dose response, cuvettes are individually placed in the Qwiklite test chamber. Once the system is activated, a high voltage, a timer counter, and a stirrer are engaged. Stirring stimulates the cells to produce bioluminescence that is detected by a photomultiplier tube (PMT). The data recorded as PMT counts can then be converted to an endpoint such as an IC50 or as toxic units used by the Environmental Protection Agency.

The data resulting from this bioassay have been found to be compatible with data derived from shrimp, fish, and bioluminescent bacteria assays.

Extreme sensitivity is achieved by operating close to single-photon counting mode. A direct-drive stirring system with

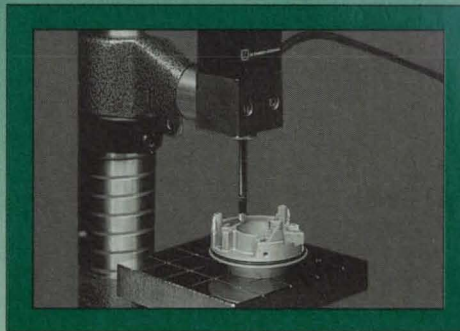


The Qwiklite bioassay system.

adjustable-speed motor uses a stainless steel shaft terminating in a plastic propeller. Other technical features are a fully adjustable timer and automated data acquisition cycle. The PMT is an RCA 8575 with S-20 response and is horizontally mounted alongside a cradle for the propeller. Dimensions of the Qwiklite controller are 21 X 25 X 15 cm. The mounted PMT chamber is 30 X 50 X 24 cm.

This work was done by David Lapota, Hugh Copeland, Gary Mastny, Dena Rosenberger, and Debbie Duckworth at the Naval Command, Control and Ocean Surveillance Center, RDT&E Division. For information about possible licensing and commercialization partnerships, contact David Lapota, NCCOSC RDT&E DIV 0143, 53560 Hull St., San Diego, CA 92152-5001; (619) 553-2798.

DIGITAL HEIGHT GAGES



HEIDENHAIN Metro and Certo digital height gages are designed for a variety of applications, including: part measurement, position measurement and motion measurement. They're ideal for inspecting parts, for monitoring, and for calibration of measuring standards, as required by ISO 9000. ■ The Metro's accuracy is $\pm 0.5 \mu\text{m}$, with measuring ranges from 12 mm to 101 mm and a measuring step of 1 μm to 0.1 μm . ■ Certo's accuracy is $\pm 0.05 \mu\text{m}$ system accuracy at 19 to 21 C, with a measuring range of 60 mm and a measuring step of 0.005 μm .



HEIDENHAIN

115 Commerce Drive, Schaumburg, IL 60173
Phone: 708.490.1191 FAX: 708.490.3931

©1995 HEIDENHAIN CORPORATION

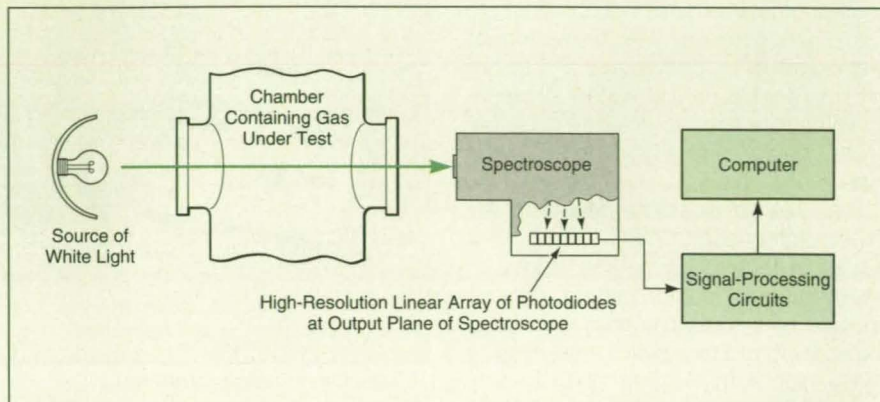
Spectroscopic Measurement of Temperature and Pressure of O₂

Measurements can be taken nonintrusively during pneumatic impact.

Lyndon B. Johnson Space Center, Houston, Texas

A spectroscopic technique (see figure) has been found to be useful in measuring the temperature and pressure of oxygen in laboratory experiments that involve high temperatures and/or high pressures. This technique was devised especially for use in experiments in which oxygen or a gas that contains oxygen is subjected to sudden adiabatic compression, as in a shock tube. This technique might also be useful in combustion experiments and other experiments in which gaseous oxygen plays a role.

This spectroscopic technique exploits temperature and pressure dependences of the absorption spectrum of the oxygen-complex molecules that form during adiabatic compression. The intensities of the double electronic absorption spectral peaks are approximately proportional to the square of the pressure, and these peaks are broadened to approximately Gaussian shapes that can be evaluated in terms of the temperature dependence of Doppler



Spectroscopy is used to measure the temperature and pressure of oxygen undergoing sudden adiabatic compression. As in other applications of spectroscopy to measurement of physical conditions in gases, the principal advantage of the use of spectroscopy (instead of solid probes) in this application is nonintrusiveness.

broadening. Furthermore, collisionally induced electronic transitions to normally spin-forbidden states have been observed, and the profiles of the P and R branches exhibit a temperature dependence consistent with a Boltzmann population distribution.

This work was done by Ralph M. Tapphorn, Dwight D. Janoff, and Norman J. Armendariz of Lockheed Engineering & Sciences Co. for Johnson Space Center. For further information, write in 116 on the TSP Request Card. MSC-21908

Digital Image Analysis of Coloration in Dyed Textiles

A simple new method detects color defects in wool-cotton blend fabrics.

Agricultural Research Service (ARS), Eastern Regional Research Center (ERRC), Philadelphia, Pennsylvania

Researchers at the US Dept. of Agriculture's ARS ERRC have developed a quick and efficient method to detect color defects in dyed textiles, one that complements conventional colorimetric instrumentation relying on color parameters to describe quality and depth of shade. Despite the recognition of wool/cotton as a desirable and unique product, limited sources for apparel, fabric, and yarns impede its availability and thus its acceptance. Part of the sourcing problem can be tied to the difficulty of dyeing wool/cotton by a simple and easy process.

The image analysis system was configured simply on a solid-state charge-coupled device (CCD) camera linked to a PC containing a framegrabber board for analog-to-digital conversion of a fabric's image. The software, run from a Windows environment, provides utilities for the access, process, display, and

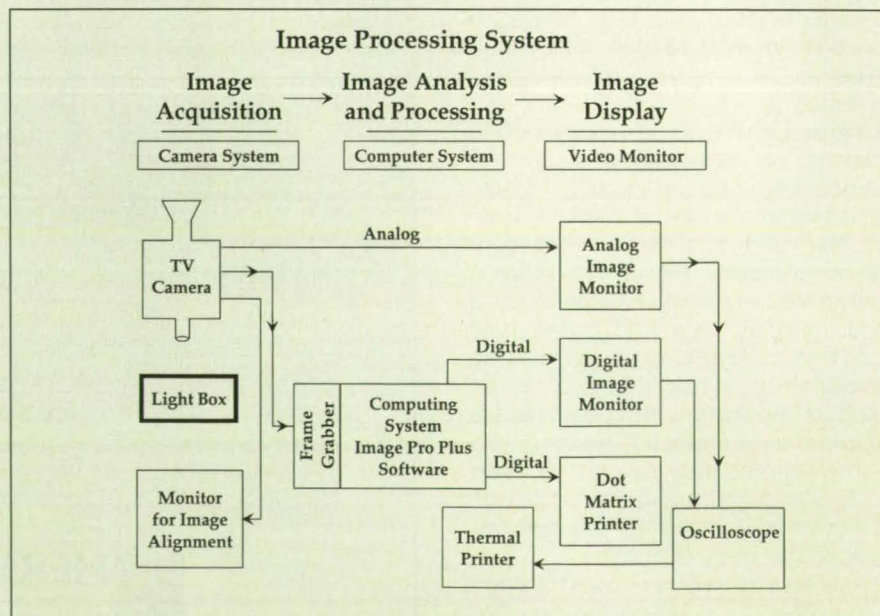


Figure 1. Schematic of the system for detecting uniform coloration in dyed textiles.

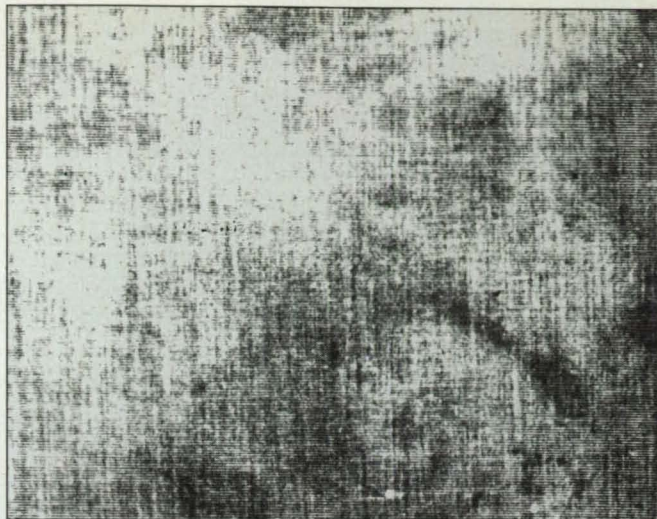
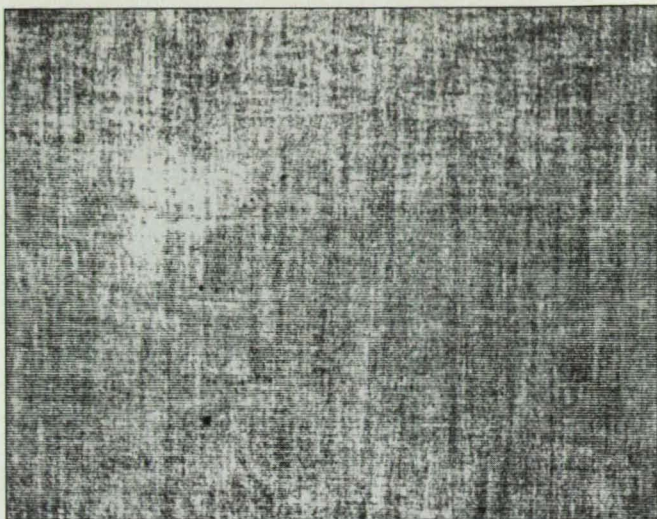


Figure 2. Photographic prints of the **video display images** of D80 (level, left) and D81 (unlevel) dyed fabrics.

manipulation of a fabric's achromatic image. The analog image of a colored fabric, displayed in shades of gray, is converted to a digital form from which data are acquired. This data can be displayed in histogram format as a frequency distribution of pixels along a gray scale of 256 brightness levels. The system is shown schematically in Figure 1.

The USDA team chemically modified cotton to make it equally competitive with wool in the dyebath. Chemical modification of cotton can occur in a pretreatment step before dyeing. The researchers borrowed the fabric pretreatment technology of using resin-amine. This technology was developed to form cationic cotton by researchers in the Textile Finishing Chemistry research unit at USDA ARS's Southern Regional Center in New Orleans.

In the wool/cotton fabric, cationic cotton will dye like wool in acidic medium with acid, direct, and reactive dyes because the amine groups on

wool become cationic under these dyebath conditions. Such pretreatments involve pad/dry/cure conditions favorable to wool.

Examination of the union cloth—having a set of wool yarns interlaced in the weaving with a set of cotton yarns—for union (one) shade involves visually comparing the sets of wool and cotton fringes. Subjective inspection, however, is seriously flawed because it is only human and leaves latitude for interpreting what constitutes a defect in a dyed textile and what the tolerance threshold for acceptance should be.

By contrast, image analysis can be used to follow the effectiveness of pretreatment processes such as the pad/dry/cure or its alternative, wet/cold batching (currently under investigation) for producing uniform fabric dyeing. It offers a new level of objectivity and accuracy, and can be readily adapted for on-line inspection without the costly investment of commercially available systems embodying sophisticated

algorithms that emulate the human vision system.

The studies applied image analysis to two different systems:

- the dyeing of cotton fabric to *level shade* for uniform coloration, and
- the dyeing of 50%/50% wool/cotton fabric to *union shade* for one color on both the wool and cotton yarns.

Figure 2 shows 100% dyed cotton fabric imaged by the system shown in Figure 1. The digital images in Figure 2 represent pixel distribution over the gray scale range for uniform or level-dyed fabric (D80) and for nonuniform or unlevel-dyed fabric (D81). The image of D81 appears relatively more uneven than D80; visually, fabric D80 is uniformly dyed and fabric D81 is splotchy in color.

Figure 3 shows how to emphasize these differences with binary images and segmentation obtained by highlighting only those pixels covering a narrow range of gray levels. The region selected for D81 was where the unlevel-

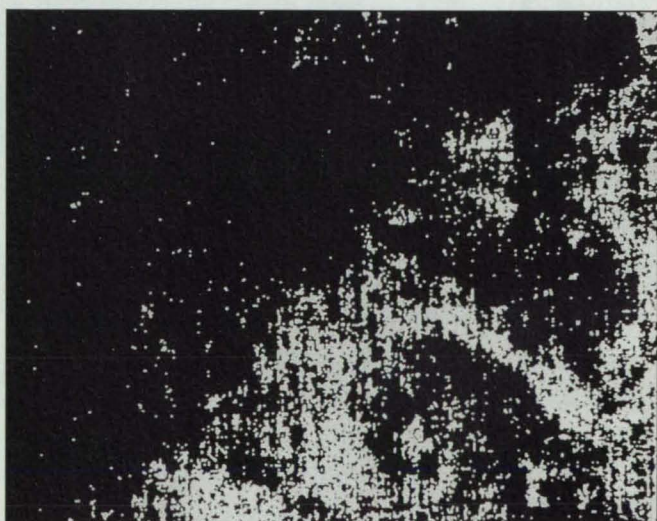
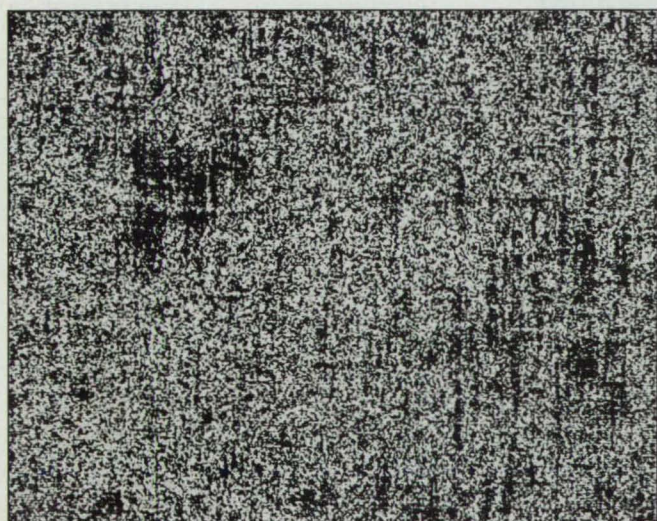


Figure 3. **Binary images** of D80 (level, left) and D81 (unlevel) segmented from the digital images.

ness was most pronounced. Now the differences between D80 for level shade and D81 for unlevel are more obvious.

The extent of levelness or unlevelness of D80 and D81 dyed fabrics can be measured from the standard deviations of their histograms, shown in Figure 4. One can derive a simple equation where the standard deviations are compared with those of either an 18% reflectance graycard or a visually perceived level-

dyed fabric. The narrow distribution of pixels around the gray-scale average for the graycard would give the lowest standard deviation. Note that the pixel distribution (and thus standard deviation) for level D80 fabric is broader than the graycard but narrower than that of unlevel D81 fabric.

Image analysis can also be used not only to indicate uniformity of color but also the actual color brightness or light-

ness as determined from the histogram's gray-scale mean. In this sense, image analysis for recording color uniformity would complement colorimetric measurement for determining color quality in the industrial dye range.

To obtain union shades, resin-amine pretreatment was applied to wool/cotton fabrics before dyeing. Figure 5 shows the histograms of these dyed fabrics with and without resin-amine

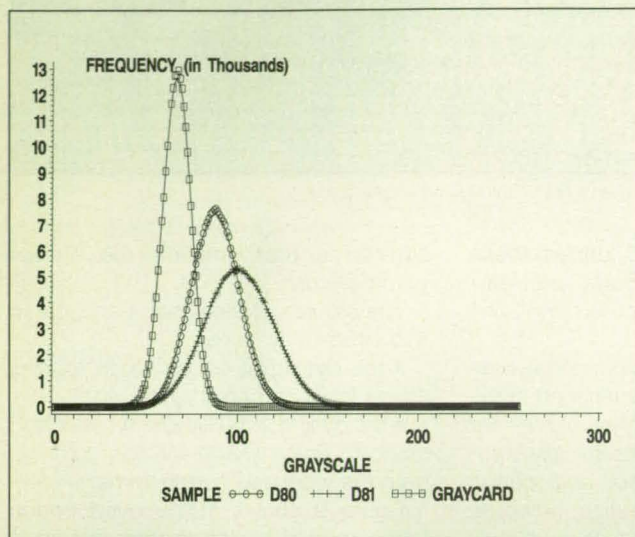


Figure 4. Histograms of gray-scale levels for graycard average, level (D80), and unlevel (D81) fabrics.

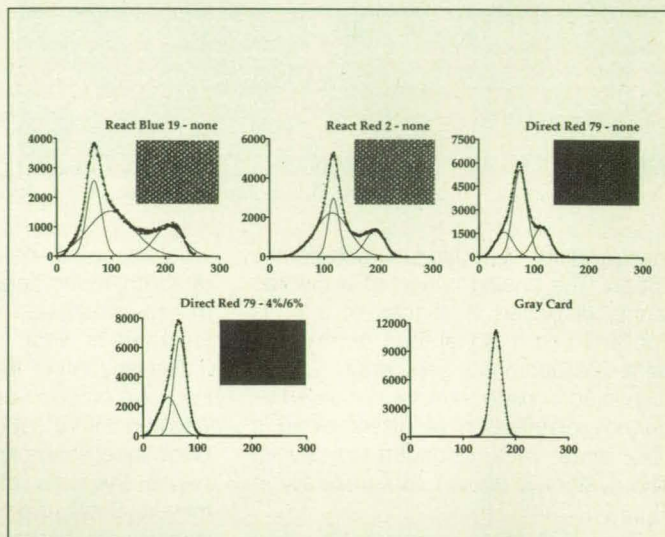


Figure 5. Union shade determination: histograms of dyed wool/cotton union fabric with and without pretreatment.

KROHN-HITE CORPORATION

99.9998%



Pure

The NEW Model 4402B Oscillator Features:

- ❑ Distortion: Typically 0.0002%
- ❑ Frequency Range: 1Hz to 110kHz
- ❑ Output Amplitude: 7Vrms/14Vrms
- ❑ Balanced 50 Ohm Output
- ❑ Amplitude Flatness: 0.02dB
- ❑ Auxiliary Outputs

Krohn-Hite Corporation
255 Bodwell Street
Avon, MA 02322 USA

\$1350.00

Call (508) 580-1660

pretreatments. In the cases of dyeing without pretreatment, the fabrics "React Blue 19—none," "React Red 2—none," and "Direct Red 79—none" the histograms are bimodal because only the wool yarns were dyed. At the camera distance of two inches, dyed and undyed yarns could be resolved. Fabric pretreatment with 4% resin/6% amine as shown in the fabric "Direct Red 79-4%/6%" resulted in the merging of the modes for a union shade. In the case of union shade, the graycard could be used as reference in a simple equation accounting for both gray-scale means and resolved constituent peak areas to arrive at a union shade index.

With digital image analysis and the fabric's histogram, objective measurements of level and union shade are possible. In the case of wool/cotton, by including the distance in gray-scale averages of the constituent peaks and their relative areas, a union shade index can be established.

The researchers believe this new system will provide important guidance for the development of new and useful textile auxiliary products to assist in dyeing because it offers greater utility than standard colorimetric methods in qualifying and quantifying uniformity of shade.

This work was done by Drs. Jeanette M. Cardamone, William C. Damert, and William N. Marmer at the US Dept. of Agriculture's **Agricultural Research Service, Eastern Regional Research Center (ARS ERRC)**.

This image analysis system can be configured from readily available components. The developers welcome the opportunity to collaborate with any company interested in scaling up the technology for use in commercial oper-

ations. Inquiries may be directed to Dr. Stephen H. Fearheller, Technology Transfer Coordinator, at USDA ARS ERRC, 600 E. Mermaid Lane, Philadelphia, PA 19118; (215) 233-6610.

Using Ultrasonic Lamb Waves To Measure Moduli of Composites

Specimens can be characterized nondestructively during fabrication and use.

Lewis Research Center, Cleveland, Ohio

Measurements of broad-band ultrasonic Lamb waves in plate specimens of ceramic-matrix/fiber and metal-matrix/fiber composite materials can be used to determine the moduli of elasticity of the materials. In one class of potential

with the same face of the specimen at a known distance and direction from the first transducer. The measurements yield data on the dispersion of Lamb waves; that is, on the speeds of sound in various acoustic modes that propagate along the

could also use it to monitor the effects of fatigue on the Young's moduli of platelike structural components in aircraft, for example.

The first antisymmetric mode provides data on variations in the shear modulus,

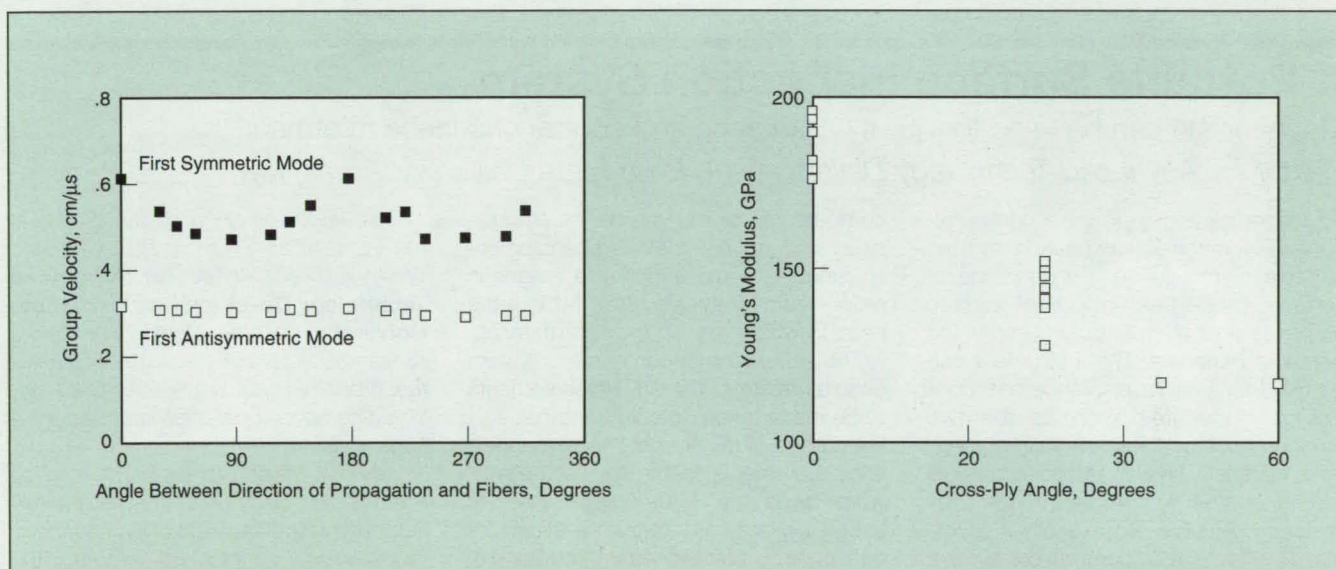


Figure 1. The **Group Velocity** of the first symmetric mode in a panel specimen of a composite of unidirectional SiC fibers in a Ti-15-3 matrix was found to vary with the direction of propagation. This variation is consistent with the Young's moduli of symmetric cross-ply specimens of the same composite with various cross-ply angles.

applications of this concept, Lamb-wave responses of specimens would be measured and analyzed at various stages of thermal and/or mechanical processing to determine the effects of the processing, without having to dissect the specimens. In another class of potential applications, structural components that have shapes that support the propagation of Lamb waves would be monitored ultrasonically to identify signs of deterioration and impending failure.

In the present Lamb-wave analysis method, pulsed acoustic excitation is applied by a first broad-band ultrasonic transducer in contact with one face of a specimen. The acoustic response is measured by use of a second broad-band ultrasonic transducer in contact

surface. The speeds of sound, in turn, can be used to calculate the moduli.

The two most useful Lamb wave modes are the first symmetric and first antisymmetric modes. The speed of sound in the first symmetric mode is a measure of the Young's modulus in the direction of propagation (see Figure 1). Thus, the Young's modulus determined by use of the first symmetric mode depends on the relative positions of the transducers. For example, one could determine the Young's modulus of a tensile specimen along the load-bearing direction, without having to stress the specimen. One could use the first symmetric mode to construct an initial Young's-modulus map of a plate before cutting the plate into specimens. One

or, under some conditions, the flexural modulus with respect to the direction of propagation. Similarly to the case of the first symmetric mode, one could use the first antisymmetric mode to construct a shear- or flexural-modulus map of a plate or to monitor the effects of fatigue on shear or flexural moduli. In addition, experiments have shown that the speed of sound in the first antisymmetric mode in ceramic-matrix composite materials is sensitive to the shear strengths of the interfaces between the matrices and the fibers (see Figure 2).

The Lamb modes are best characterized by constructing dispersion curves. For this purpose, it is necessary to determine the phase velocity for each mode of interest. Previously, this was

done by collecting data from a tone-burst measurement at each frequency of interest. However, collecting data separately at each frequency is a time-consuming task. The advantage of the present broad-band pulse measurement concept is that each pulse contains a range of frequencies, so that each measurement can contain data on all frequencies of interest. To extract these data, the acoustic response signals are processed by software that separates the frequencies, determines the velocities, and plots the dispersion curves. The software provides the speed and automation necessary for application to research on materials and to monitoring of components during service or processing.

This work was done by Harold E. Kautz of Lewis Research Center. For further information, write in 2 on the TSP Request Card. LEW-15907

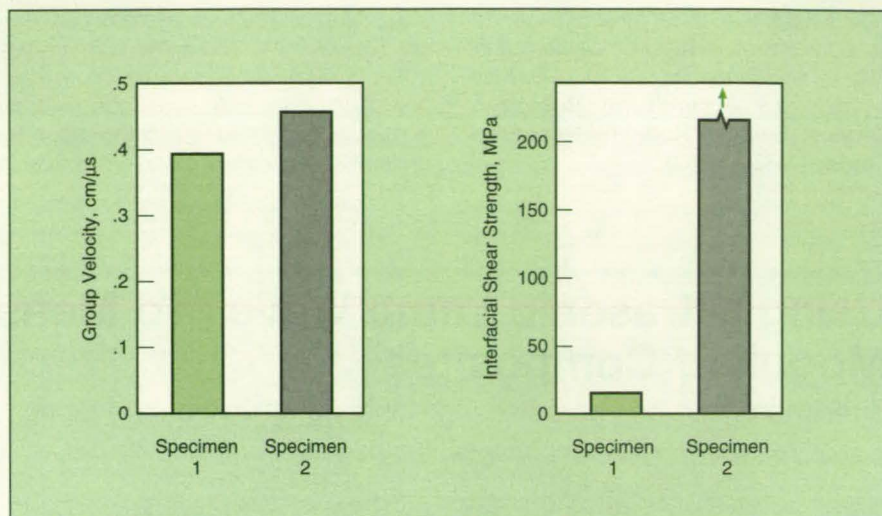


Figure 2. The **Shear Strengths of the Interfaces** between the fibers and matrices in two different composites of silicon carbide fibers in reaction-bonded silicon nitride matrices, as measured by the fiber-push-out method, were found to be semiquantitatively related to each other in the same way as were the group velocities of the first antisymmetric mode in those composites.

A Portable Surface Inspection System

Magneprobe can be used for quality assurance and control of surface treatment.

Center for Advanced Technology Development, Iowa State University, Ames, Iowa

Magneprobe is a portable computer-controlled magnetic inspection system capable of measuring a wide range of surface properties including surface hardness and microstructure hardening depth of materials. The instrument can be used for quality assurance and control of procedures such as the two named above and shot peening of magnetic materials, as well as nondestructive testing of steel structures through their structure-sensitive properties: for example, to ensure that compressor turbine blades have been given the correct heat treatment to minimum acceptable mechanical property standards.

The instrument is lightweight and compact. It is controlled from a small portable

computer with a commercial data acquisition system. The metrology equipment is capable of measuring the magnetic properties of materials *in situ* without the need to wind a coil on the test material.

The software that controls the system enables state-of-the-art measurements to be made by an operator who has little knowledge of the finer points of magnetic measurements. In this respect the software turns the Magneprobe into an expert system with its own routines for drift control, precision demagnetization, and deconvolution of the surface magnetic properties of the test material from the raw data of the measurement and calibration routines for stress detection, for example.

This work was done by David Jiles at the Institute for Physical Research and Technology's Center for Advanced Technology Development, Iowa State University, for the Dept. of Energy's Ames Laboratory. A package of intellectual property rights is available to license, including several patents/patent applications and software.

Inquiries may be directed to Lisa Kuuttila, Director, Office of Technology Commercialization, Center for Advanced Technology Development, Room 151, ASC II, Iowa State University, Ames, IA 50011; (515) 294-5121; FAX (515) 294 9519.

Measuring Traces of Oxygen by Resonant Electron Attachment

Relative concentrations below 1 ppb can be detected.

NASA's Jet Propulsion Laboratory, Pasadena, California

A method of detecting trace amounts of oxygen is based on dissociative attachment of electrons to oxygen molecules (in the reaction $e^- + O_2 \rightarrow O + O^-$) followed by measurement of the resulting flux of negative oxygen ions in a mass spectrometer. High sensitivity is achieved in this method by exploiting a resonance

in the dissociative attachment of electrons to oxygen molecules: the electron-attachment cross section rises to a high peak at an incident electron kinetic energy of 6.2 eV.

The method was devised to increase the sensitivity of detection of oxygen in processing chambers in which oxygen is

regarded as a contaminant; for example, chambers used in making semiconductor devices and in growing high-purity crystals. The sensors of most commercial instruments designed for measuring traces of oxygen contamination are electrochemical cells. These instruments generally cannot detect oxygen at relative

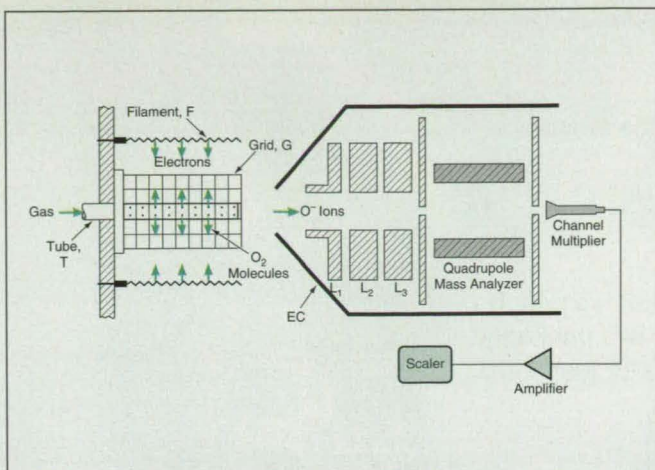


Figure 1. The **Prototype Oxygen-Contamination Sensor** exploits resonant electron attachment to achieve high sensitivity.

concentrations less than about 50 parts per billion (ppb). An atmospheric-pressure ionization mass spectrometer has the potential for measuring relative concentrations of some gas species below 1 ppb, but has not been tested on oxygen.

A prototype oxygen sensor that implements the present resonant-electron-attachment/mass-spectrometry method is sensitive enough to measure the relative concentration of oxygen well below 1 ppb. The prototype sensor (see Figure 1) includes a cylindrically shaped reversal electron-attachment detector. The mass spectrometer used to sample the O^- contains a quadrupole mass analyzer (QMA). Gas to be analyzed enters the instrument through stainless-steel tube T, which is perforated on the vacuum side to allow gas to effuse. Electrons are produced at filament F.

Electric potentials are applied to T and F and to cylindrical grid G between them in periodic pulses in coordination with the potentials applied to the electrodes of the QMA. During the "electrons on" portion of the operating cycle, the potentials on F, G, and T are chosen so that the electrons from F are accelerated through G, then decelerated and reflected

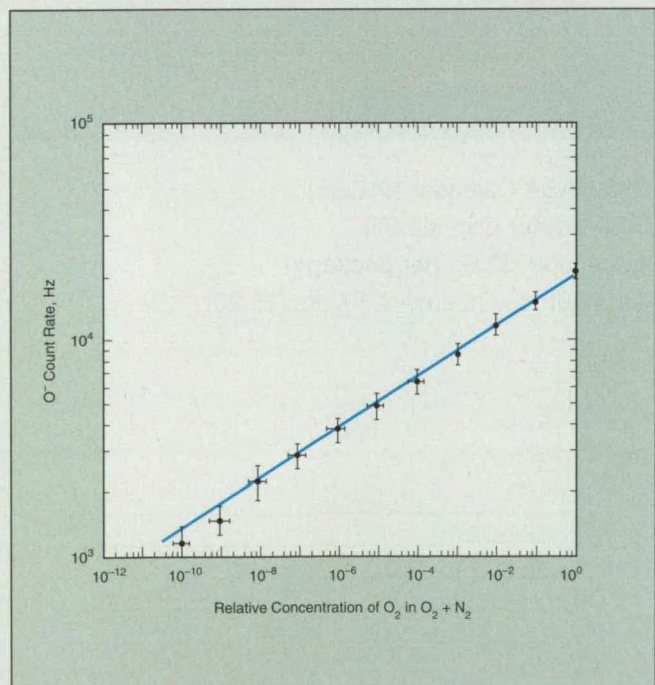


Figure 2. The **Response of the Prototype Sensor** demonstrates sub-ppb sensitivity at relative concentrations below 10^{-10} .

near the surface of T. In the reflection (reversal) region, the electrons have a range of kinetic energies from 0 to several eV, depending on the applied potentials. Those that have kinetic energies around 6.2 eV produce many O^- ions from the O_2 effusing through the T.

During the "electrons on and ions off" period, the EC and L_1 electrodes are held at ground potential so as not to generate an electric field that could interfere with the electric field in the interaction region. During the second half of the cycle, "electrons off and ions on," the potentials are chosen so that electrons are not accelerated toward T and the electric field from the EC, L_1 , L_2 , and L_3 electrodes extracts the O^- ions from the interaction region. The extracted ions are focused into the QMA and detected in a channel multiplier. The output of the channel multiplier is amplified, then counted by a single-channel scaler with a variable dwell time.

Figure 2 shows results of a test of the prototype apparatus on mixtures of known small concentrations of O_2 in N_2 . These results clearly demonstrate that high sensitivity can be achieved. Even higher sensitivity could be achieved by use of increased electron current, improved ion-extraction optics, and a more sensitive mass spectrometer.

This work was done by Kin Fung Man, Said Boumsellek, and Ara Chutjian of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 33 on the TSP Request Card.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, NASA Resident Office-JPL; (818) 354-5179. Refer to NPO-19098.

DATATAKER 50

The Perfect Data Logger

Rugged
Versatile
Low Cost
Dependable



Complete and ready to go, the Datataker 50 is a self-contained, stand-alone microprocessor-based battery powered data logger that measures inputs from most types of sensors. • The Datataker 50 is equally at home in the remote outdoors, and the demanding workplaces of industry, to monitor and log temperatures, pressures, flow, strain, load, position, humidity, and almost any other type of information. • The basic unit comes complete with software, cable, battery and AC power pack.

FEATURES

- $\pm 25\text{mV}$, $\pm 250\text{mV}$ and $\pm 2500\text{mV}$ voltage ranges
- Current, 4-20mA, resistance and bridge ranges
- 16 bit, autocalibrating, autoranging ADC
- 5 differential/10 single ended analog channels
- 5 digital I/O channels, 3 high-speed counters
- Fully supports all commonly used sensors
- Alarms, real time statistics and calculations
- Log data in internal memory or PCMCIA cards
- Connects to any computer or PLC via RS232
- **Microsoft Windows compatible**

ONLY
\$1495



DATA ELECTRONICS USA, INC.

17941 Skypark Circle, Suite H • Irvine, CA 92714
714/851-5300 • Fax: 714/851-5303 • **1-800-9-LOGGER**

High-Tech Holiday **Gift** Ideas

1996 NASA Calendar

Each month features a full-color photo of the space shuttle in action. Includes historic launch dates from the 1960s to present.

\$10.95



Astronaut Ice Cream/Sandwich

The perfect stocking-stuffer! Freeze-dried, vacuum-packed ice cream treats just like the ones enjoyed by astronauts in space. Two packages – an ice cream sandwich and a neapolitan ice cream mix – for just \$5.95.



NASA Vector Cap

Red, white, and blue NASA logo on a high-quality white poplin cap.

Size-adjustable. \$9.95



Planets Sweatshirt

Striking color images of the 9 planets in our solar system. Quality white sweatshirt, adult sizes only: M, L, XL, XXL.

\$19.95



Apollo 13 Commemorative T-Shirt

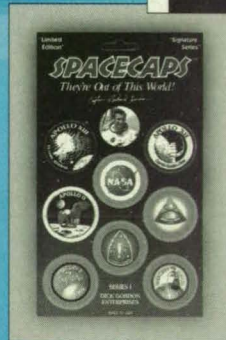
A great memento for space and movie buffs! Features a gorgeous full-color rendition of the official Apollo 13 mission emblem (the "Horses of Apollo") superimposed with dramatic effect on a black T-shirt.

Adult sizes: S, M, L, XL. \$13.95



Spacecap "Pogs"

Limited edition collector Pogs feature official full-color logos of Mercury, Gemini, and Apollo missions, as well as the NASA vector logo. Order today – they will be gone tomorrow. \$3.95



Order by November 30 for pre-Christmas delivery.

Rush me the following: (list quantity)

☐ Planets Sweatshirt (\$19.95)

circle size(s): M L XL XXL

☐ Apollo 13 T-Shirt (\$13.95)

circle size(s): S M L XL

☐ 1996 NASA Calendar (\$10.95)

☐ NASA Vector Cap (\$9.95)

☐ Spacecaps (\$3.95 per package)

☐ Astronaut Ice Cream – 2 Packs (\$5.95)

Add \$5.00 to order for postage/handling. (NY residents add sales tax to total.)

Total: \$ _____

☐ check enclosed (payable to Associated Business Publications)

☐ charge my: ☐ VISA ☐ Mastercard ☐ AmEx

Account No. _____

Expire Date _____

Signature _____

Name _____

Company (if applicable) _____

Address _____

City/St/Zip _____

Phone No. _____ Fax No. _____

Mail with payment to: Associated Business Publications, 317 Madison Avenue, Suite 921, New York, NY 10017.
Or fax (credit card orders) to (212) 986-7864. Questions? Call Demi at (212) 490-3999.

Double-Knudsen-Cell Apparatus Measures Alloy-Component Activities

Both cells are maintained at the same temperature.

Lewis Research Center, Cleveland, Ohio

A double-Knudsen-cell apparatus has been developed for use in measuring alloy-component activities. Alloy-component activities are important for many aspects of metallurgy. They are used to predict chemical reactions, processing characteristics, and oxidation properties. The most direct indicators of activities are vapor pressures, which can be measured by use of Knudsen cells. In this context, "activity" denotes the ratio between the vapor pressure of a given component material of an alloy and the vapor pressure of that component material in pure form at the same temperature.

The double-Knudsen-cell apparatus operates in conjunction with a mass spectrometer that is used to measure the vapor pressures, as shown schematically in Figure 1. It also includes the pure component, which eliminates the problem posed by variations of calibration parameters when samples are changed in a conventional single-cell apparatus.

The major technical issues associated with this apparatus are the need for uniform heating of the Knudsen cells, translation of the cells, and separation (that is, minimizing mixing) of the molecular beams that emerge from the two cells. Figure 2 shows some aspects of the design of the apparatus that address these issues.

Heating is accomplished by use of a tantalum heating element bent into a serpentine configuration that tends to minimize gradients of temperature. The tantalum heating element is installed adjacent to a tantalum block, which also helps to minimize gradients of temperature. The two Knudsen cells are mounted in this block and are thus assured of being at the same temperature. The temperature of the cell under examination is measured by use of an optical pyrometer aimed into the cell through the cell orifice.

The cell-and-heater assembly is located in an evacuated enclosure (which is not shown in the figures), the vacuum of which communicates with that of the mass spectrometer. The cell-and-

heater assembly is translated within this enclosure by a commercial x-y motion feedthrough. The assembly is mounted on a stainless-steel cross with ball bearings. This cross is attached to the motion feedthrough via a rigid stainless-steel tube.

The apparatus includes flexible water feedthroughs and copper braid, which, in combination, supply heater power while providing water cooling of translatable heater-contact blocks. The commercial motion feedthrough has been modified by the addition of stepping motors and a joystick controller. The position of the cell-and-heater assembly is measured by use of linear potentiometers attached mechanically to the motion feedthrough, and the position is indicated on digital readout devices. A telescope (also not shown) that is part of the pyrometer provides a visual indication of the cell under study as the cell is moved into and out of the vapor-pressure-measurement position.

A novel system of shutters controlled from outside the vacuum system is used to prevent mixing of the vapor beams that emerge from the two cells. Thus, the cell not being sampled can be shut off while the other is undergoing examination. Measurements have shown that mixing amounts to a few percent or less.

The apparatus was tested on Ag/Cu and Fe/Al alloys, for which excellent data are available in the literature. The data obtained in the tests were in very good agreement with those in the literature. In addition, a partial molar heat of vaporization

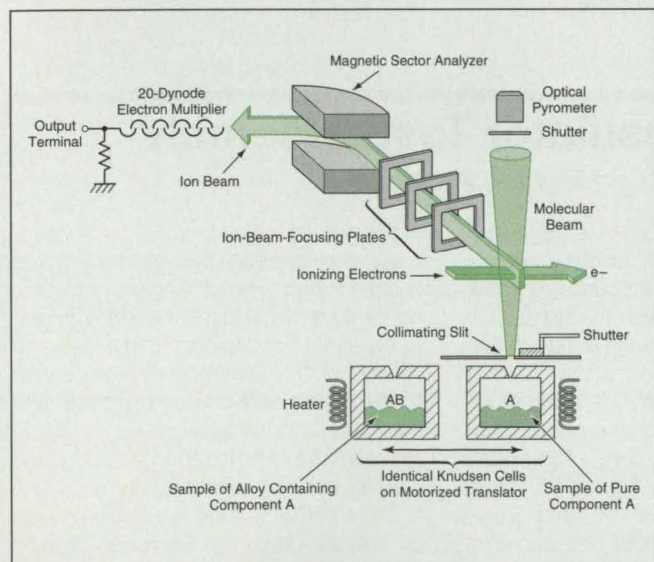
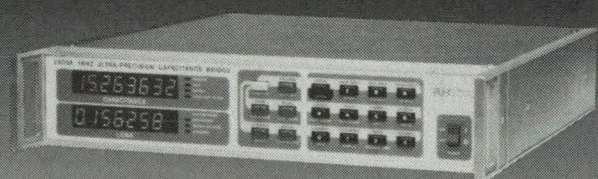


Figure 1. The Double-Knudsen-Cell Apparatus provides a molecular beam from a selected one of two Knudsen cells. The molecular beam is directed into a mass spectrometer for measurement of the vapor pressure of a selected material component — in this case, pure component A.

STOP MANUALLY BALANCING!



THE WORLD'S MOST ACCURATE AUTOMATIC CAPACITANCE/LOSS BRIDGE, THE MODEL 2500A: AUTORANGING AUTOCALIBRATION AUTOBALANCE

APPLICATIONS INCLUDE:

- Ultra-Low Temperature Studies
- Cryogenic Magnetometry
- Liquid/Vapor Levels
- Studies on Dielectrics, Thermal Expansion, Pressure, AC Resistance, Contaminants, Thickness of Metals or Dielectrics, Monitoring of Chemical Reactions, and Direct Humidity.

Specifications of Model 2500A with Option E:

- Accuracy of 3 ppm
- Stability better than 0.5 ppm/year
- Resolution of 0.5 attofarad and 0.07 ppm
- Temperature coefficient of 0.01 ppm/°C
- Conductance as low as 3×10^{-7} nanosiemens
- Dissipation as low as $1.5 \times 10^{-8} \tan \delta$
- IEEE-488 and RS-232 interfaces included
- **COMPREHENSIVE 300+ PAGE MANUAL**

FOR MORE INFORMATION, CONTACT:

ANDEEN-HAGERLING, INC.
AH 31200 Bainbridge Rd.
Cleveland, Ohio 44139-2231 U.S.A.
Phone: (216) 349-0370 Fax: (216) 349-0359

LITERATURE SPOTLIGHT

Free catalogs and literature for *Federal Lab Tech Briefs* readers. To order, write in the corresponding number on the Reader Information Request Form (page 97).



CLUTCHES AND BRAKES

Six-page fold-out brochure for design engineers, specifiers and users describes how to control tension and torque precisely, repeatedly and automatically without wearing parts. Contains features, benefits, typical applications, quick selection graphics,

specifications, dimensions and operating guidelines for all sizes of magnetic particle clutches, brakes and electronic controllers. Magne Corporation, 9380 Watson Industrial Drive, St. Louis, MO 63126; Tel: (314) 968-9500; Fax: (314) 968-3030.

Magne Corporation

For More Information Write In No. 334



TOOLS, TOOL KITS, CASES & TEST EQUIPMENT

Installation/repair tools, tool kits, test equipment, telecom equipment, LAN testers & instrument/shipping cases are detailed in this 300+ page full-color catalog. Includes products for field service & depot repair. Indexed catalog features over 100 standard tool kits & complete information on "customizing" to meet specific customer requirements. Complete specs & prices are provided for all products. Tel: 800-866-5353; Fax: 800-234-8286.

Specialized Products Co.

For More Information Write In No. 335



Apollo 11 Commemorative Sweatshirt

Striking full-color illustration on quality white shirt recaptures the spirit and excitement of the Apollo moon landing. Available in adult sizes-S,M,L,XL \$19.95 each plus \$5.00 shipping/handling. (NY residents add sales tax.)

Mail with payment to: Associated Business Publications 317 Madison Avenue, Ste 921, New York, NY 10017. For credit card orders call (212) 490-3999

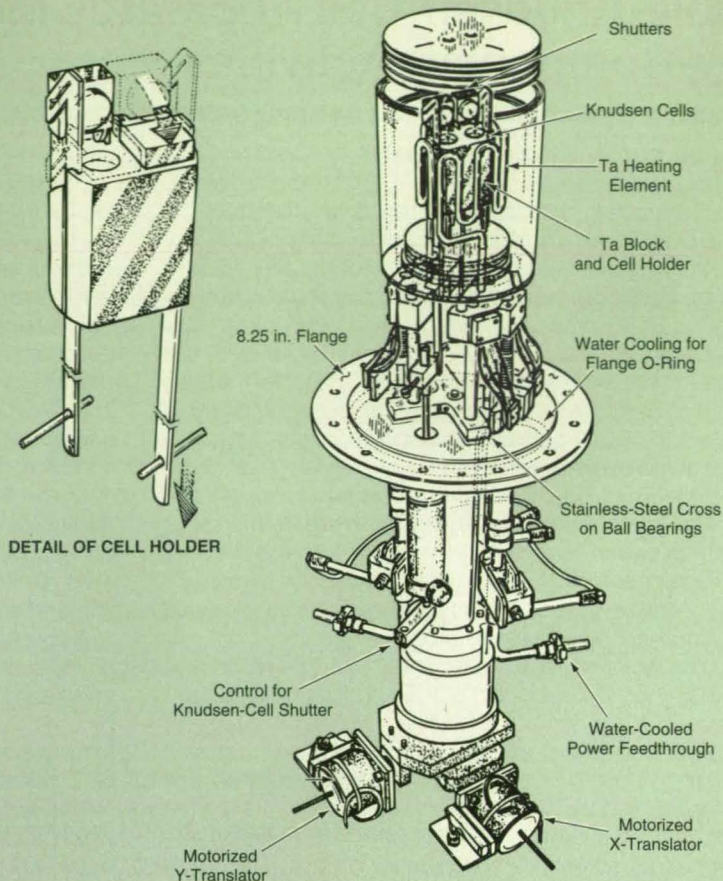


Figure 2. The Apparatus Is Designed to minimize undesired thermal gradients, provide appropriate translation to place the selected cell in position for sampling, and minimize mixing of the molecular beams from the cells.

of Al in an alloy of 0.526Fe/0.474 Al was calculated by plotting the logarithm of the activity of aluminum vs. the reciprocal of the absolute temperature, and the results agreed with data in the literature.

This work was done by Nathan S. Jacobson and Warren A. Moore of **Lewis Research Center**. For further information, **write in 98** on the TSP Request Card. LEW-16075

Flexseal Insulator Test Assembly

Marshall Space Flight Center, Alabama

A small-scale version of a solid-fuel rocket motor flexseal nozzle bearing assembly that can be instrumented and tested in a compression-testing fixture simulating conditions during rocket motor operation is described in a report. Flexseal bearing assembly is a structure used to attach a vectorable nozzle to a solid-fuel rocket motor case. This small-scale version includes a flexseal core and a flexseal insulator, each of which consists of three rubber pads between two shims and two steel endrings. The core and insulator shims are made of mild steel and tape wrapped with carbon-cloth phenolic, respectively. The core and insulator are assembled with a rubber

buffer pad between them. By simultaneously compressing the assembly while orienting it at various angles, one produces strain fields in the assembly, similar to the strain fields expected in a full-scale version of the assembly. By measuring these strains and comparing them with theoretical predictions, one can calibrate structural models for the geometry and loading conditions of the fixture.

This work was done by Eric Buchanan of Thiokol Corp. for **Marshall Space Flight Center**. For further information, **write in 92** on the TSP Request Card. MFS-28911



Books & Reports

These reports, studies, and handbooks are available from NASA as Technical Support Packages (TSPs) when a Request Card number is cited; otherwise they are available from the NASA Center for Aerospace Information.



Machinery

Further Study of Face Gears for Helicopter Transmissions

A document describes theoretical, computational, and experimental studies of the feasibility of proposed lightweight, split-torque helicopter transmissions based on face gears. [The majority of the work described in the document was also described in a prior document that was the subject of "Face Gears for Helicopter Transmissions" (LEW-15840), NASA Tech Briefs, Vol. 18, No. 9 (September, 1994), page 130.] The studies concentrated largely on a specific conceptual split-torque face-gear transmission. Experiments demonstrated the feasibility of face gears in high-speed, high-load applications like those of helicopter transmissions.

This work was done by F. L. Litvin and J.-C. Wang of the University of Illinois at Chicago; R. B. Bossler, Jr., of Lucas Western, Inc.; Y.-J. D. Chen and G. Heath of McDonnell Douglas Helicopter Co.; and D. G. Lewicki of the Vehicle Propulsion Directorate of the U. S. Army Research Laboratory for Lewis Research Center. To obtain a copy of the report, "Face-Gear Drives: Design, Analysis, and Testing for Helicopter Transmission Applications," write in 32 on the TSP Request Card. LEW-16193

Research in Diagnosing Bearing Defects From Vibrations

A report describes research in bearing-defect signature analysis — the use of vibration-signal analysis to diagnose defects in roller and ball bearings. Experiments were performed on bearings in good condition and other bearings in which various parts were scratched to provide known defects to be correlated with vibration signals. The experiments were performed on a highly instrumented motor-driven rotor assembly at speeds up to 10,050 r/min (167.5 Hz), using accelerometers, velocity

probes, and proximity sensors mounted at various locations on the assembly to measure vibrations. An acoustic-emission probe was also used to obtain sensitivity to vibrations at frequencies into the megahertz range, where signals are relatively uncontaminated by the structural, rotordynamic, and environmental noise that typically floods traditional sensors at lower frequencies. The various sensor outputs were digitized and characterized by both conventional linear signal-analysis techniques (e.g., power-spectral-density analysis) and advanced nonlinear signal-analysis techniques (e.g., bicoherence analysis). Traditional low-frequency (< 20 kHz) analysis and high-frequency envelope analysis of both accelerometer and acoustic-emission data were used to recover characteristic bearing-distress information buried deeply within the recorded signal data.

This work was done by T. Zoladz, E. Earhart, and T. Fiorucci of Marshall Space Flight Center. To obtain a copy of the report, "Bearing Defect Signature Analysis Using Advanced Nonlinear Signal Analysis in a Controlled Environment," write in 35 on the TSP Request Card. MFS-27326



Physical Sciences

Microchemical Analysis of Space Operation Debris

A report discusses techniques used in analyzing debris relative to space shuttle operations. The debris are collected from the space shuttle, expendable launch vehicles, payloads carried by the space shuttle, and payloads carried by the expendable launch vehicles. The debris samples are often small and contaminated by oil or organic components. Optical microscopy, scanning electron microscopy with energy-dispersive spectrometry, analytical electron microscopy with wavelength-dispersive spectrometry, and X-ray diffraction have all been chosen as techniques to be used in examining samples of debris. A combination of all these techniques has proven

most effective in qualitative and quantitative characterization of debris samples.

This work was done by Virginia J. Cummings and Hae Soo Kim of Kennedy Space Center. To obtain a copy of the report, "Procedures for Analysis of Debris Relative to Space Shuttle Systems," write in 39 on the TSP Request Card. KSC-11695

Experiments on No-Vent Filling of a Tank With Liquid H₂

A report describes experiments on no-vent filling of an insulated, vacuum-jacketed tank with liquid hydrogen. The experiments, conducted in a laboratory in normal Earth gravity, were conducted to ascertain the feasibility of no-vent filling of tanks with cryogenic liquids in zero gravity, where filling with venting as in normal gravity could cause substantial loss of the liquids. The no-vent-filling process begins with a preparatory phase in which the cryogenic liquid is sprayed onto the walls of the tank to cool them, then the resultant vapor is vented. Thereafter, there is no further venting, and the liquid is sprayed into the tank to mix it with the ullage vapor. By filling the tank in this manner, the vapor is kept cool enough so that the pressure in the tank does not rise to a level at which it would prevent filling of most of the tank with liquid. The tank used in the experiments had a volume of 71 ft³ (2 m³); the experiments were conducted at inlet saturation pressures of 5, 15, and 25 psia (34, 103, and 172 kPa, respectively), at transfer pressures of 20, 30, and 45 psia (138, 207, and 310 kPa, respectively), and at various starting wall temperatures. Two spray systems were used. One was a series of small holes along a length of pipe. The other was a single orifice at the bottom of the tank. Although pretest analysis predicted superior performance for the series of holes, both systems proved effective in filling the tank. In all of the experiments except the one at the highest starting wall temperature [238 R (132 K)], it was possible to fill at least 90 percent of the volume of the tank with liquid hydrogen. The overall results of the test agree fairly well with a mathematical model based on equilibrium thermodynamics.

This work was done by D. J. Chato of **Lewis Research Center**. To obtain a copy of the report, "Ground Testing for the No-Vent Fill of Cryogenic Tanks: Results of Tests for a 71 Cubic Foot Tank," **write in 23** on the TSP Request Card. LEW-16161

Molecular Beams To Simulate Impinging Rocket Exhaust

A report discusses the development of a small-scale apparatus to generate molecular beams for use in simulating the impingement of rocket-engine exhaust on nearby spacecraft surfaces. To create the simulated exhaust, gases of interest are made to flow into a conical expansion nozzle, where irradiation by a pulsed laser beam heats the gases, accelerating the gas molecules to high speeds. The use of a pulsed (instead of a continuous) source eliminates the need for heavy vacuum pumping. The use of laser (instead of combustion) heating enables the selection of both molecular species and velocities.

This work was done by George E. Caledonia, Robert H. Krech, and Bernard L. Upschulte of Physical Sciences, Inc., for **Marshall Space Flight Center**. To obtain a copy of the report, "Plume Impingement Effects," **write in 22** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-5419. Refer to MFS-26292

Predictions of Accretion of Ice on a Commercial Airplane

A report presents a computational study of the accretion of ice on the wings and on the horizontal tail surfaces of a simplified version of the Boeing 737 airplane. The calculations were performed by use of the LEWICE3D computer code, which incorporates a panel-method mathematical model of three-dimensional potential flow and mathematical models of trajectories of drops of water entrained in the flow, impingement of drops on surfaces, and transfer of heat. The calculations were performed for airspeeds and airfoil configurations typical of a 30-minute hold condition (cited as a crucial design condition for ice protection systems). Calculations were performed for two types of flow models; a model of flow around the whole airplane, and a simplified model in

which the wing and horizontal tail surfaces were treated as though each moved through the air in isolation from the rest of the airplane: this was done to assess the validity of using such simplified models. In general, the calculated ice shapes looked reasonable and appeared representative of rime and a mixed ice. With respect to the wing, the simplified model gave results consistent with those of the full-aircraft model, except at the wing root, where it overpredicted the amount of accreted ice relative to the full-aircraft model. For the tail, the sizes and amounts of ice computed with both models were comparable, but the accretions were located more toward the upper surface for the full model than they were for the simplified model: the difference was attributed to downwash from the main wing, with a resultant lower effective angle of attack of the tail in the full model relative to that of the simplified model.

This work was done by C. S. Bidwell of **Lewis Research Center**. To obtain a copy of the report, "Ice Accretion Prediction for a Typical Commercial Transport Aircraft," **write in 93** on the TSP Request Card. LEW-15975

Determination of LETs of SRAMs by Use of a Laser

A report describes an experimental study of the use of the microelectronic advanced laser scanner (MEALS) to cause single-event upsets (SEUs) in integrated logic circuits. [The basic concepts of SEU testing by use of the MEALS were described in several previous articles in *NASA Tech Briefs*; namely, "Laser Scanner Tests for Single-Event Upsets" (NPO-18216), Vol. 16, No. 2 (February, 1992), page 36; "Single-Event-Upset Laser Scanner With Optical Bias" (NPO-18217), Vol. 16, No. 2 (February, 1992), page 36; and "More About Laser Scanner Tests for Single-Event Upsets" (NPO-18494), Vol. 17, No. 1 (January, 1993), page 56.] The MEALS includes a pulsed dye laser, the output of which is focused onto the device under test. This study is part of a continuing effort to study the SEU effects of ionizing radiation on such circuits and to use the MEALS as a relatively inexpensive SEU-prescreening laboratory apparatus that would serve as an alternative to a heavy-ion accelerator. In this study, the lowest linear energy thresholds (LETs) at 125 °C for SEU in a 64K static random-access memory (SRAM) were found to be 27 MeV·cm²/mg and 24 MeV·cm²/mg, as measured by use of a heavy-ion accelerator and the MEALS, respectively. In the case of a

radiation-hardened SRAM, no SEUs were observed even at the maximum LET (79 MeV·cm²/mg) of the heavy-ion test beam, while MEALS tests indicated an SEU LET of 90 MeV·cm²/mg. These results suggest that the MEALS can be used as an SEU-prescreening laboratory apparatus in certain cases.

This work was done by Quiesup Kim, Kenneth P. McCarty, Charles E. Barnes, Harvey R. Schwartz, and James R. Coss of Caltech for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "Single Event Effects and Laser Simulation Studies," **write in 64** on the TSP Request Card. NPO-19315

Laser-Based Instrument Measures Propagation of Cracks

A report describes the use of a commercial laser displacement meter to measure the propagation of cracks in stainless-steel specimens in stress tests in a corrosive (salt-spray) environment. The measurements were directed toward determining the time from the beginning of each test until the onset of propagation of the crack. Displacements measured were of the order of microns.

This work was done by Rupert U. Lee of **Kennedy Space Center** and Robert B. Cox, Robert C. Youngquist, John T. Sentz, and Kenneth A. Rose of I-Net. To obtain a copy of the report, "Crack Initiation Sensor," **write in 25** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center; (407) 867-2544. Refer to KSC-11697.

Temperature and Density Measurements Using O₂ Fluorescence

A report presents a theoretical and experimental study of the use of laser-induced fluorescence in oxygen to measure temperatures and densities in air flowing in a hypersonic wind tunnel. In this application, oxygen is excited by narrow-band, tunable radiation from a pulsed ArF excimer laser. It was found that for temperatures of 60 K and densities above 0.01 amagat, the temperature and density measurements can be accurate to within 2 percent if signal uncertainties are dominated by photon-statistical noise. The measurements are unaffected by collisional atomic quenching.

This work was done by Robert L. McKenzie and Douglas G. Fletcher of

Ames Research Center and *Gabriel Laufer of Analatom, Inc.* To obtain a copy of the report, "A Method for Measuring Temperatures and Densities in Hypersonic Wind Tunnel Air Flows Using Laser-Induced O₂ Fluorescence," **write in 26** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Ames Research Center; (415) 604-0753. Refer to ARC-12856.



Mechanics

Experiments on Vibration-Induced Loosening of Bolts

A report describes an experimental study of loosening of bolts in the presence of vibrations. Eleven design parameters that were considered likely to affect the tendency to loosen were evaluated for relative importance. These parameters were the bolt diameter, lubrication on the bolt, lubrication on mating materials, bolt-hole tolerance, preload, nut-locking device, grip length, thread pitch, class of fit, joint configuration, and mass of configuration. Bolts were tested in vibration for two values of each design parameter. The most significant parameters were found to be the type of nut-locking device, the joint configuration, bolt diameter, and the mass of the configuration; larger bolts resist loosening better than smaller bolts do, and transverse loading is much more detrimental to maintenance of bolt tightness than is axial loading.

This work was done by G. Ed Ramey and Robert C. Jenkins of Auburn University for **Marshall Space Flight Center**. To obtain a copy of the report, "Experimental Analysis of Thread Movement in Bolted Connections Due to Vibrations," **write in 10** on the TSP Request Card. MFS-27325

Study of Tracing of Airflow With Neutrally Buoyant Bubbles

A report describes a study of the use of neutrally buoyant bubbles to make airflows visible. The equation of motion for a single bubble was derived and evaluated by use of a computational scheme to determine the factors that affect the trajectory of a bubble, particularly with respect to the degree

to which bubble trajectories adhere to or deviate from flow-field streamlines. A two-dimensional-flow experiment was conducted, using an airfoil in a wind tunnel at 0° angle of attack along with a commercial bubble generator that made specially formulated soap bubbles containing helium. The bubble trajectories in the stagnation region of the airfoil were measured and compared with trajectories predicted by the computational scheme for bubbles of various sizes and densities. A bubble-tracing experiment was also conducted on the three-dimensional flow about a 30° swept semispan wing with simulated glaze ice, and the results of this experiment were compared with those of Navier-Stokes calculations of the flow and of a surface-oil-flow-visualization experiment. The conclusion drawn from the theoretical and computational parts of the study is that neutrally buoyant bubbles can trace even the most complex flow patterns. The conclusion reached from the experimental part of the study is that it is difficult to produce neutrally buoyant bubbles and, therefore, the use of bubbles to trace airflows should be limited to qualitative observations unless care is taken to ensure neutral buoyancy.

This work was done by Michael F. Kerho of the University of Illinois for **Lewis Research Center**. To obtain a copy of the report, "A Study of the Accuracy of Neutrally Buoyant Bubbles Used as Flow Traces in Air," **write in 9** on the TSP Request Card. LEW-16085



Electronic Systems

Study of Partial-Band Detection of Frequency-Hopped Signals

A paper presents a comparative theoretical study of the performances of alternative schemes for partial-band detection of frequency-hopped signals. The basic mathematical model of the study is that of (a) reception of M -ary ($M \geq 2$) frequency-shift-keyed data modulation on a carrier signal that has been hopped to any of G different available frequencies and (b) frequency channelization in the front end of the receiver effected by a fast-Fourier-transform (FFT) preprocessor that, at any given time, can be tuned to one of a number of nonoverlapping frequency subbands, each of which contains $\rho_0 G$ frequen-

cy-hop channels (where $\rho_0 < 1$; that is, the FFT frequency band is only a part of the overall frequency-hop band). This model opens up a range of options for partial-band-detection: At one extreme, one could keep the receiving band fixed at one of the subbands, with the consequence that, on the average over time, one would intercept only a fraction ρ_0 of all hops; at the other extreme, one could tune the receiver in discrete steps over the entire frequency-hop band, thus intercepting all hops but sampling only ρ_0 of the available signal during each hop. Using routine simplifying assumptions and standard detection-performance criteria, the alternative schemes were analyzed as applied to a hypothetical system with specifications similar to those of a U. S. Army transceiver. The numerical results lead to the conclusion that the best detection performance would be achieved by keeping the receiving band fixed, thereby making more reliable decisions within each observed frequency channel during each hop, even though not all hops would be intercepted.

This work was done by Barry K. Levitt, Marvin K. Simon, Andreas Polydoros, and Unjeng Cheng of Caltech for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "Partial-Band Detection of Frequency-Hopped Signals," **write in 48** on the TSP Request Card. NPO-19226



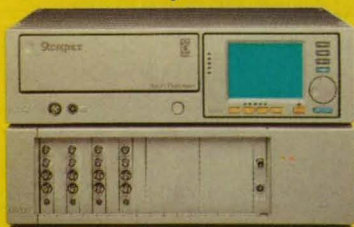
Materials

Hazardous Fluids Compatibility Test Apparatus

A document describes a test apparatus designed to hold test tubes containing hazardous fluids such as hydrazine, nitrogen tetroxide, or ammonia. The test tube can be suspended over a water bath or other solution or mixture. Control of the test sample can be performed by one-hand operation within a fume hood or glove box. The system is adaptable for automated control of the lowering and raising of the test samples.

This work was done by Frank Flores and James Daniel of Lockheed Engineering and Sciences Co. for **Johnson Space Center**. To obtain a copy of the report, "Hazardous Fluids Compatibility Test Apparatus," **write in 84** on the TSP Request Card. MSC-21826

BURP



With a 51.2 Megabit data rate, Storeplex Delta has a bigger appetite than any other portable recorder.

Up to 64 mixed analog/digital channels. 96 dB dynamic range with better than 1 degree phase accuracy. 51.2 Megabits of data per second. Variable speed operation with a 512:1 range. Direct to computer high speed data transfer via SCSI interface. Our new portable will digest anything you feed it.

RACAL Communicating through technology

Racal Recorders Inc., 15375 Barranca Parkway, Suite H-101, Irvine, CA 92718. Tel: (714) 727 3444/(800) 847 1226. Fax: (714) 727 1774.

For More Information Write In No. 482



Magnetic Heat Pump Containing Flow Diverters

Flows that mix heated and cooled fluid would be suppressed.

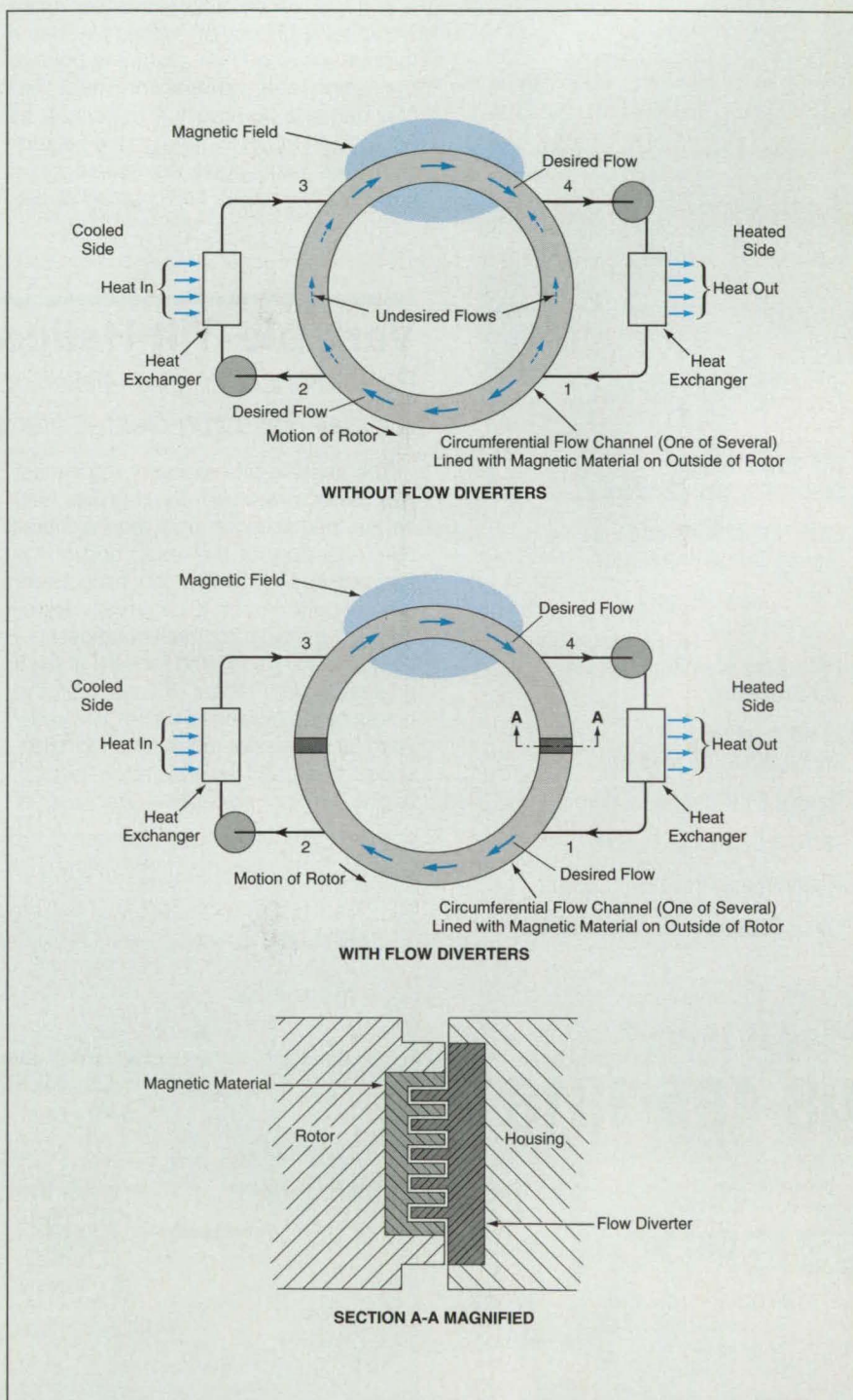
John F. Kennedy Space Center, Florida

A proposed magnetic heat pump would contain flow diverters for suppression of undesired flows. If left unchecked, these undesired flows would mix substantial amounts of partially heated and partially cooled portions of a working fluid, effectively causing leakage of heat from the heated side to the cooled side. By reducing the leakage of heat, the flow diverters would increase the energy efficiency of the magnetic heat pump, which potentially offers an efficiency greater than that of a compressor-driven refrigerator.

In a magnetic heat pump of the type in question, a magnetic rotor would play a role analogous to that of the compressor in a compressor-driven heat pump. The outer surface of the rotor would include circumferential channels lined with, and separated by, walls and partitions containing a magnetic material. As shown in the figure, pumps would circulate the working fluid between heated-side and cooled-side heat exchangers. These pumped flows would be coupled into and out of the circumferential channels of the rotor via stationary ports in a housing in which the rotor turned.

The direction of rotation of the rotor would be opposite the intended direction of the pumped flows. At one location in its circumferential travel (between points 4 and 3 in the figure), the magnetic material would pass through a magnetic field, which would align magnetic moments of electrons in the magnetic material and thereby heat the electrons. The heat thus generated would be transferred to the rest of the magnetic material and then to the working fluid flowing toward the heated-side heat exchanger. The heated-side heat exchanger would transfer heat to the environment on that side.

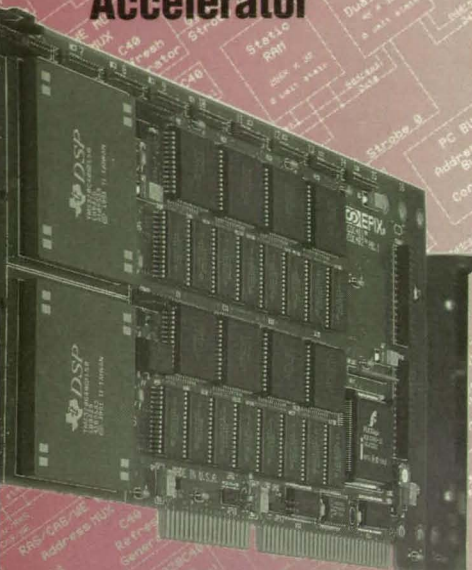
When the magnetic material left the magnetic field at point 3, the freeing of the magnetic moments of the electrons would cool the magnetic material; because this magnetic cooling would occur immediately after the transfer of heat to the fluid during travel through the magnetic field, the magnetic material would emerge from the magnetic field



The **Flow Diverters** would concentrate most of the flow of the working fluid into the long outer loop, minimizing the undesired flow along the short paths from point 2 to point 3 and from point 1 to point 4, respectively.

COC402™

Image Processing Accelerator



- 550 MOPS Image Processing Accelerator
- Dual TMS320C40 50 MHz Digital Signal Processors
- 4 MB Image Memory per Processor
- 1 MB Zero Wait State SRAM per Processor
- 32 KB Dual Port Communication Memory
- Twelve 8 bit Communication Ports
- 32/16/8 Bit Image Access
- Independent Processor Control
- Video Capture with 4MEG VIDEO™

Need it today?

708-465-1818



EPIX, Incorporated
381 Lexington Drive
Buffalo Grove, IL 60089 USA
Tel - 708 465 1818
Fax - 708 465 1919
EPIX@EPIXINC.COM

©1995 EPIX, Inc.

For More Information Write In No. 423

cooler than it was before it entered the magnetic field. Continued rotation would carry the cooled magnetic material through the region between points 2 and 1, where it would cool the working fluid flowing toward the cooled-side heat exchanger. In the cooled-side heat exchanger, the working fluid would absorb heat from the environment on that side. From there, the fluid would flow into the rotor at point 3, then enter the portion of the rotor in the magnetic field, completing the magnetic heat-pump cycle.

In the absence of flow diverters, there would be spurious flows along two paths through the rotor: from point 2 to point 3, bypassing the cooled-side heat exchanger; and from point 1 to point 4, as part of a short circuit through the heated-side heat exchanger. Accordingly, two flow diverters would be mounted at dia-

metrically opposite points, as shown in the figure. Each flow diverter would be a comblike object with tangs that would fill most of the cross sections of the circumferential channels in the rotor. The gaps between the flow diverters and the walls of the channels would be just large enough to allow the rotor to turn freely, and small enough that there would be very little flow through them. Thus, the flow diverters would almost completely block the undesired flow paths, forcing most of the fluid to follow the desired long path through both heat exchangers and the rotor.

This work was done by Frank S. Howard of Kennedy Space Center. For further information, write in 19 on the TSP Request Card. KSC-11622

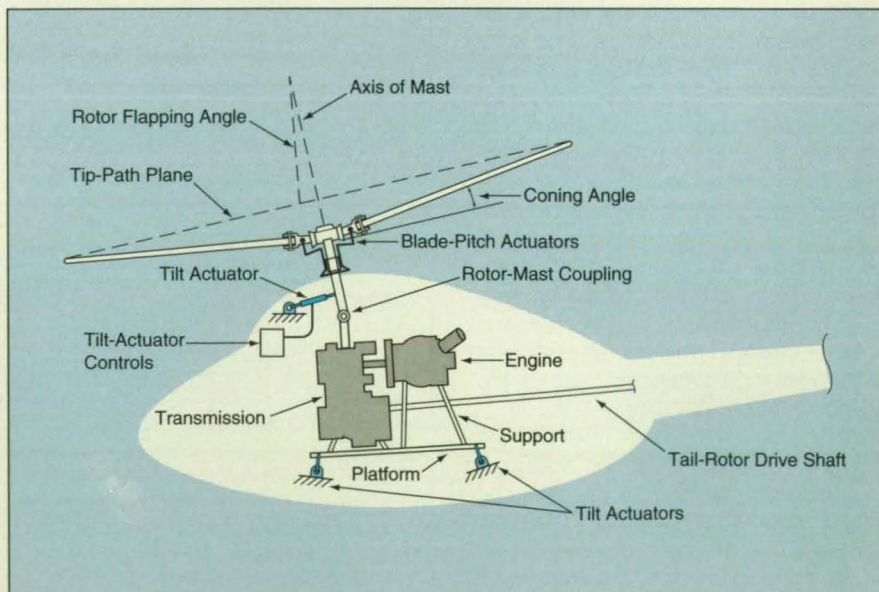
Variable-Tilt Helicopter Rotor Mast

Performance, energy efficiency, and safety would be enhanced.
Langley Research Center, Hampton, Virginia

The variable-tilt helicopter rotor mast has been proposed to improve helicopter performance and reduce vibration, especially at the upper end of the forward-speed range of helicopters [above 140 knots (21.2 m/s)]. Heretofore, the main rotor masts of most helicopters have been tilted forward at fixed angles, usually about 5°, so that the noses of the fuselages do not tilt downward at excessive angles during high-speed flight and so that rotor flapping angles are not excessive. Because of

the increase in speeds attainable by newer helicopters, the extreme nose-down attitudes cause drag and down-load losses and, consequently, a need for more power.

The fixed forward tilt of the mast in a helicopter also necessitates a nose-high hover attitude, which is generally undesirable; for example, if the mast is tilted 5° forward, then the hover attitude for the pilot in the fuselage is 5° nose up. Thus, the increase in attainable speed makes it increasingly difficult to operate



Variable Tilt could be achieved by use of a universal coupling in the main rotor mast or by tilting the entire engine-and-transmission platform.

NASA Tech Briefs, November 1995

a fixed-tilt-mast helicopter at a satisfactory attitude over the entire range of velocities and other flight conditions; the selection of a fixed mast tilt becomes a design compromise between the angle needed in forward cruise and the undesirable nose-up attitude in hover.

Designing a helicopter to incorporate a variable-tilt mast would make it possible to optimize the tilt for each flight condition; in particular, variable forward tilt to reduce the power needed by reducing aerodynamic drag and download and to reduce rotor vibratory loads via a decrease in the rotor flapping angle (the angle between the plane of the rotor-tip path and the axis of the mast). Variable lateral tilt of the main rotor mast could be used to balance the tail-rotor thrust and the aerodynamic side forces on the fuselage. Variable tilt would also contribute to safety by reducing the extreme nose-up angles that cause loss of visibility to pilots.

The tilt could be varied by use of a universal coupling in the main rotor mast and hydraulic or electric actuators connected to the mast between the main rotor and the coupling. Additional actua-

tors could be used for redundancy or for additional variable tilt in other planes (e.g., lateral tilt). Tilt could be controlled manually, or else automatically with manual override. In automated control, sensors would detect the operational state of the helicopter and, in response to the sensor outputs, the actuators would be commanded to tilt the mast to the angle that yielded the best combination of fuselage attitude and flapping angle. Manual override of automated tilt control would be made available to enable the pilot to respond to system failures and other special conditions.

According to an alternative variable-tilt concept, the main rotor mast would remain fixed and the entire engine-and-transmission platform would be tilted. In this case, the tail-rotor drive shaft would have to be designed to accept the tilt, inasmuch as the tail rotor is driven by the main transmission.

This work was done by Henry L. Kelley of the U. S. Army Aeroflight Dynamics Directorate at Langley Research Center. No further documentation is available. LAR-13779

"Beach-Ball" Robotic Rovers

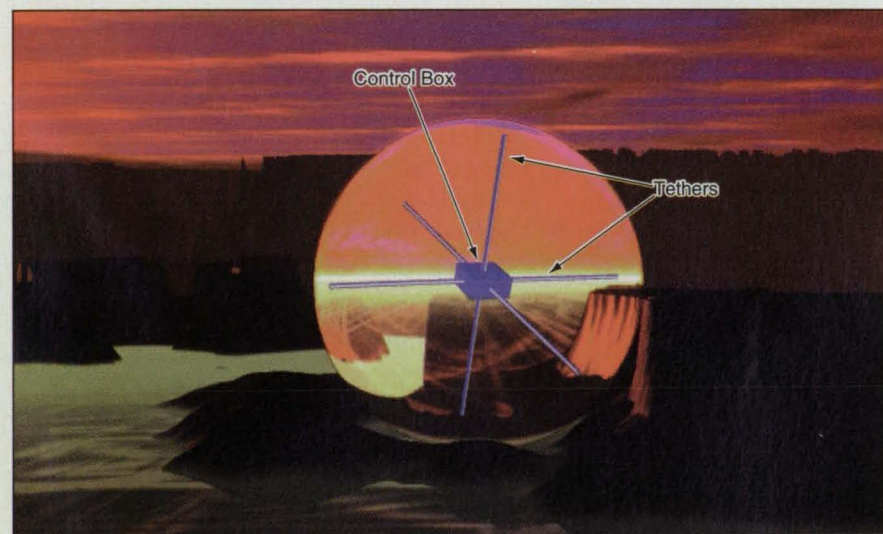
Instruments could be carried over rough terrain.

NASA's Jet Propulsion Laboratory, Pasadena, California

Robotic vehicles that resemble large beach balls have been proposed for carrying scientific instruments. Conceived for use in exploring the planet Mars, these vehicles might also be useful on Earth; for example, to carry meteorological or pollution-monitoring equipment to

remote locations across rough terrain and even across water.

Each vehicle would feature an approximately spherical balloonlike outer shell inflated to a suitable pressure. Three diametral tethers approximately perpendicular to each other would be attached



The **Control Box** would move itself along the tethers to shift the center of gravity, causing the vehicle to roll.

FREE SAMPLE CD-ROM

ENGINEERING INNOVATIONS ON CD-ROM. DESIGNED TO HELP YOU STAY



ONE STEP AHEAD.

Track worldwide
developments
in your industry

Monitor your
competitors'
research activities

Identify new applications

Save design and
production time

Using patent information to identify critical engineering innovations in your industry has never been easier. To find out more, call Derwent today. Mention this ad and we will take \$100 off your 1995 subscription and send you a FREE sample CD-ROM.



DERWENT
Scientific and Patent Information

800-451-3451

to the shell, effectively defining an approximate Cartesian coordinate system within the shell. A control box containing motors and power and control circuits would move itself along the tethers and adjust the lengths of the tethers in a coordinated fashion to shift the center of gravity and thereby cause the shell to roll in a desired direction (see figure).

Unlike traditional wheeled vehicles, which must be kept generally upright to

maintain functionality, the proposed vehicles would remain functional in any orientation. Consequently, the proposed vehicles would be less vulnerable to loss in falls from cliffs or rolls down steep slopes.

Depending on the specific intended application, a spherical shell could be inflated to a pressure high enough to make the shell relatively rigid or to a lower pressure to make the shell somewhat flexible and squishy. Alternatively,

instead of a shell, a structure of approximately spherical outline could be made of twisted rods; of course, this structure would not be suitable for traversing water or thick vegetation.

This work was done by David E. Smyth of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 7 on the TSP Request Card. NPO-19272

Apparatus Would Measure Temperatures of Ball Bearings

Marshall Space Flight Center, Alabama

A rig for testing ball bearings under radial and axial loads and measuring their surface temperatures is undergoing development. The information to be obtained by this rig could be important because operating surface temperatures can affect the service lives of bearings. The rig includes extensible thermocouples: by means of bellows as longitudinal positioners,

the thermocouples would be driven into contact with the bearing balls to sense their temperatures immediately after a test run. Unlike in the cases of some other bearing-testing rigs, it would not be necessary to disassemble the rig or to section the balls to obtain indirect indications of (discolorations of) maximum temperatures reached. The thermocouple measure-

ments would also indicate temperatures better than do temperature-sensitive paints.

This work was done by John C. Gibson and Thomas H. Fredricks of Marshall Space Flight Center. For further information, write in 76 on the TSP Request Card. MFS-31067

NEW!

One-Piece Design — Expanded Control Capability

**HIGH
RESOLUTION
CCD CAMERAS
FROM
KODAK**



The KODAK MEGAPLUS Camera, Model 1.4i offers:

- Flexible camera operation through RS-232 or RS-422 serial control.
- 8 bit digital output and resolution of 1.4 million pixels.
- 6.9 frames-per-second.
- Ask about Kodak's complete line of Megapixel CCD Cameras.

For more information call:
800-462-4307, Ext. 625

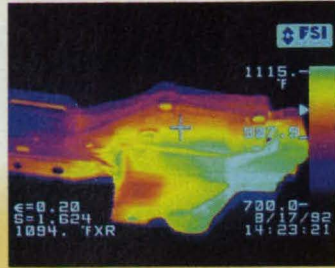
EASTMAN KODAK COMPANY
MOTION ANALYSIS SYSTEMS DIVISION



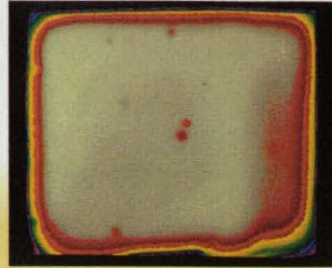
Engine development



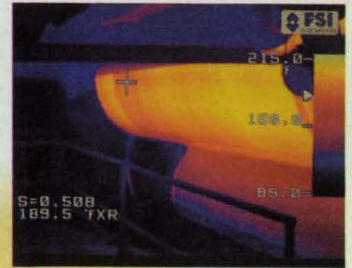
Measure casting temperatures



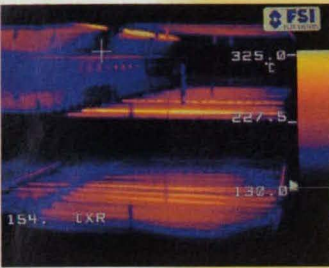
Defects in composite materials



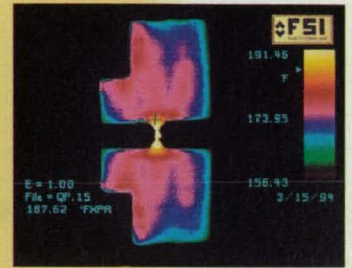
Moisture content in paper



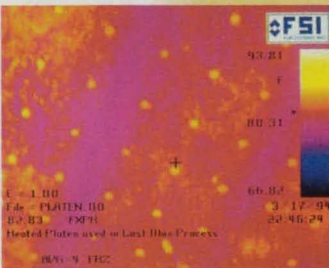
Monitor soldering processes



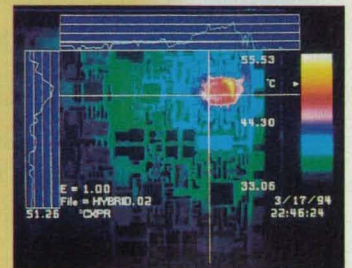
Injection mold performance



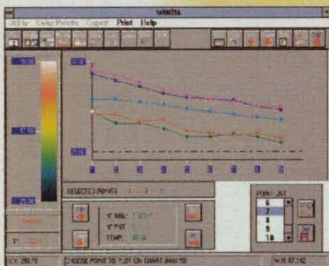
FLIR SYSTEMS POINTS OUT YOUR DEFECTS WITH WARMTH AND SENSITIVITY.



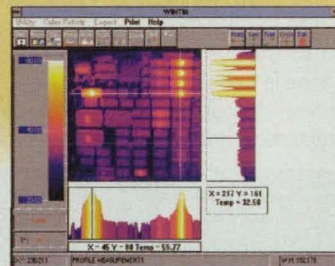
Evaluate wax injection presses



Hybrid circuit failure analysis



Analyze trend data



Post-processing thermal analysis



A variety of desktop,
portable and hand-held systems
to fit your needs

Our infrared (IR) imaging products detect and measure a variety of thermal conditions through easy-to-use, non-contact infrared imaging technology.

What's more, we have the industry's broadest selection of IR products: the IQ Series of real-time image processing systems; the hand-held Prism infrared cameras; Windows™-based image analysis software; and a full range of accessories. So whether you work in R&D, process monitoring and control or non-destructive testing, let our skilled applications engineers help you solve your problems. Call FLIR Systems at 1-800-322-3731 for more information or to arrange for a sample IR analysis at your site or in our laboratory.



16505 SW 72nd Ave., Portland, OR 97224, (503) 684-3731, Fax (503) 684-3207

Windows is a trademark of Microsoft Corporation

For More Information Write In No. 501



Flexible Borescope for Inspecting Ducts

Marshall Space Flight Center, Alabama

A borescope and associated equipment have been developed specifically for use in optical inspection of the inside of flexible joints in a rocket-engine fuel duct. The apparatus includes an assembly, characterized as a "mouse/canoe," at the sensing end of a 10-ft (3-m) borescope cable. The borescope tip rides in the mouse/canoe. The mouse/canoe is made laterally compressible, to

facilitate movement past constrictions and to provide a fixed distance from the inspection point that permits its accurate description in a duct being inspected. The cable is covered by an outer sheath, which provides rigidity and controls legs that are connected to the back of the mouse/canoe. The legs help to orient the mouse/canoe between the flexible joint tripod legs within the duct.

A metal nose and wire whiskers attached to the front of the mouse/canoe aid in the insertion.

This work was done by Keith Shinozaki, Mike P. Armstrong, and Ron Urquidi of Rockwell International Corp. for Marshall Space Flight Center. For further information, write in 27 on the TSP Request Card. MFS-30003

Texturing Copper To Reduce Secondary Emission of Electrons

Ion-beam texturing produces clean surfaces with reduced secondary electron emission.

Lewis Research Center, Cleveland, Ohio

An ion-beam process produces clean, deeply textured surfaces on copper substrates. In the presence of incident electron beams, the ion-textured surfaces exhibit reduced (in comparison with untreated copper surfaces) emission of secondary electrons. Ion-beam-textured copper would be especially useful for making collector electrodes for traveling-wave-tube and klystron microwave amplifiers, in which secondary emission of electrons is undesirable because it reduces efficiency.

After ion-beam texturing, a copper surface consists of a dense, uniform array of pointed spires about 10 μm high, spaced about 5 μm apart (see Figure 1). The secondary-electron emission of the textured surface is 40 to 60 percent less than that of untreated copper. Most of the electrons in an impinging beam strike the bases or sloping walls of the spires; secondary electrons emitted from these regions are repeatedly intercepted by nearby spire walls with partial retention upon each interception, so that the net emission is greatly reduced.

The ion-beam texturing process is a triode sputtering process in which a copper substrate and a molybdenum target are simultaneously exposed to an argon plasma in a low-pressure environment. The molybdenum target is a ring that is

placed between a cathode and the substrate and is centered on the vertical axis that runs from the cathode to the substrate (see Figure 2). The axial (vertical) distance from the target to the substrate is approximately equal to the radius of the substrate; this distance is chosen, on the basis of experience, because it results in a uniformly textured surface.

In the presence of the argon plasma, an accelerating potential of 1,500 Vdc is set up between the cathode and the substrate. The current that flows from the cathode to the substrate is maintained at a level that yields a current density of about 5 mA/cm^2 on the substrate surface to be treated. The accelerating potential is also applied to the

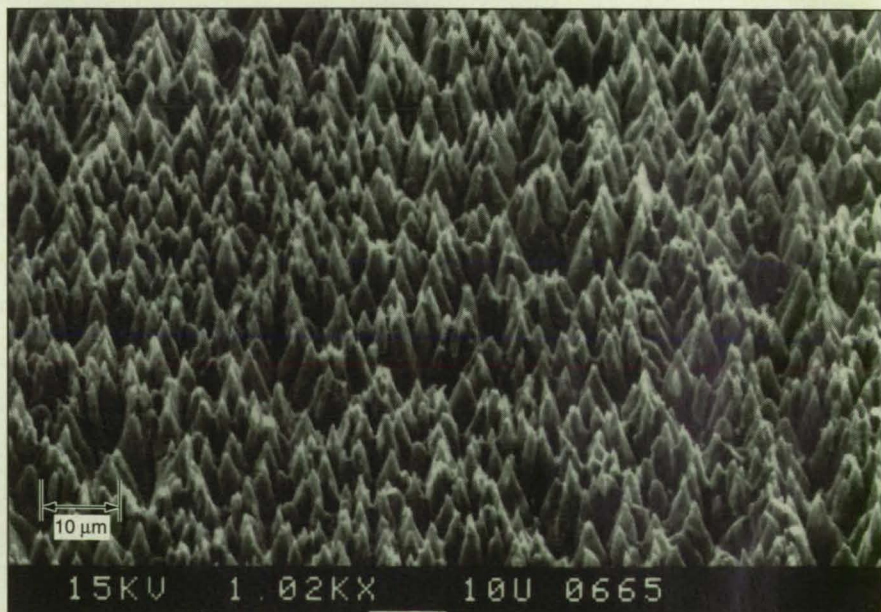


Figure 1. This **Scanning Electron Micrograph**, taken at an angle of 30° from perpendicular to the nominal surface of a copper substrate, shows the forest of spires formed by ion-beam texturing.

target, but in pulsed form; it is switched on and off at a frequency of 20 Hz by use of a switching module. [The switching module is described in "High-Voltage MOSFET Switching Circuit" (LEW-15986) elsewhere in this issue of NASA Tech Briefs.] During the periods when the accelerating potential is not applied to the target, the entire current passes through the substrate, but when the target potential is switched on, the current is divided between the target and the substrate. The process is continued for 1 hour.

Unlike in previous methods of texturing copper with ion beams, this method provides control (via the frequency and duration of pulses of accelerating potential)

over the amount and the rate of arrival of texture-inducing molybdenum at the surface of the copper. Unlike in some older methods, molybdenum residue (which can constitute a contaminant under some circumstances) is not present in significant amounts in treated copper substrates.

This work was done by Kenneth A. Jensen, Arthur N. Curren, and Robert F. Roman of **Lewis Research Center**. For further information, **write in 91** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Lewis Research Center; (216) 433-5753. Refer to LEW-15988.

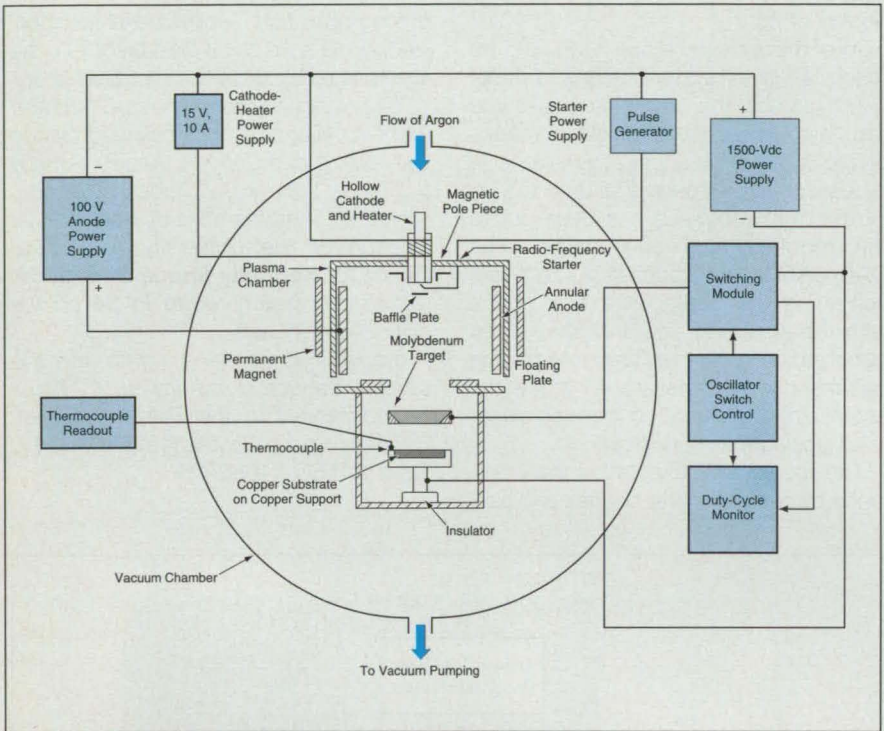


Figure 2. In the **Ion-Beam Texturing Process**, a molybdenum ring target is positioned above and around the copper substrate. The target potential is repeatedly switched on and off.

Automated Laser Cutting in Three Dimensions

The velocity, position, and angle of the cut are varied under computer control.

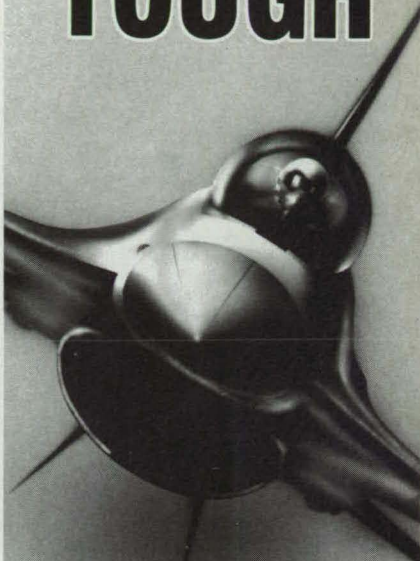
John F. Kennedy Space Center, Florida

A computer-controlled machine-tool system uses a laser beam assisted by a directed flow of air to cut refractory materials into complex three-dimensional shapes. In the original application for which the system was designed, the materials in question were thermally insulating thick blankets and tiles used on the space shuttle. The system can

shape a tile to concave or convex contours and can cut beveled edges on a blanket, without cutting through an outer layer of quartz fabric that is part of the blanket.

The system (see figure) includes a 50-W continuous-wave carbon dioxide laser and associated optics, a subsystem that positions and orients the work-

GET TOUGH



MIL Spec QPL Rotary Switches & Switching Systems

Reliability... in even the toughest environments. It's why the world's military, aviation and aerospace contractors rely extensively on Janco switching technology to keep their programs flying high and trouble free. To put all the reliability of rotary to work for you—contact Janco today to discuss your application and for your **free Engineering and Selector Guide**.



Janco

3111 Winona Avenue, Burbank, CA 91504.
Phone: (818) 846-1800.



KEEP PACE WITH EMERGING TECHNOLOGIES

PARTICIPATE IN THE MIT ADVANCED STUDY PROGRAM

The Advanced Study Program of the Center for Advanced Educational Services at the Massachusetts Institute of Technology is a unique, individualized course of study that offers engineers, scientists, and technical managers

- the opportunity to study emerging technologies first-hand, increase professional capabilities, and broaden perspectives;

- on-campus curriculum formats tailored to the backgrounds of individual participants and the needs of their organizations.

Divided into 16-week segments which coincide with the MIT Fall and Spring terms, the Program combines academic courses and seminars with guided independent study and research.

Participants are provided on-campus offices, computer facilities, a videotape library, and a private lounge in the Center for Advanced Educational Services building. In addition, participants may use MIT resources such as libraries and athletic facilities.

For complete information, contact:

Dr. Paul E. Brown, Director
Advanced Study Program
MIT/CAES, Room 9-335N
Cambridge, MA 02139-4307
USA

Telephone: (617) 253-6128
Fax: (617) 258-8831
e-mail: pebrown@mit.edu

piece in 5 degrees of freedom, a system controller, a computer work station equipped with computer-aided-design/computer-aided-manufacturing (CAD/CAM) software, and a machine-vision subsystem that locates and measures the workpiece. By use of the CAD/CAM software, the computer work station generates a three-dimensional mathematical model of the workpiece, and CAD/CAM postprocessing software uses the mathematical model to compute effective cutting tool paths for the workpiece-positioning subsystem. In addition, the CAD/CAM software incorporates empirical equations that compute optimum values of laser power, air-flow parameters, and positioner velocities to achieve the specified depth and quality of cut.

After the workpiece has been cut, the machine-vision system scans a laser beam across the workpiece, and the resulting succession of digitized images of the laser spot on the workpiece is processed into dimensional data to verify that the workpiece has been cut to the required size and shape. The CAD/CAM postprocessing software compares the actual size and shape with the specified size and shape and generates corrective laser-machining commands, if necessary, to make the actual size and shape conform as closely as possible to specifications.

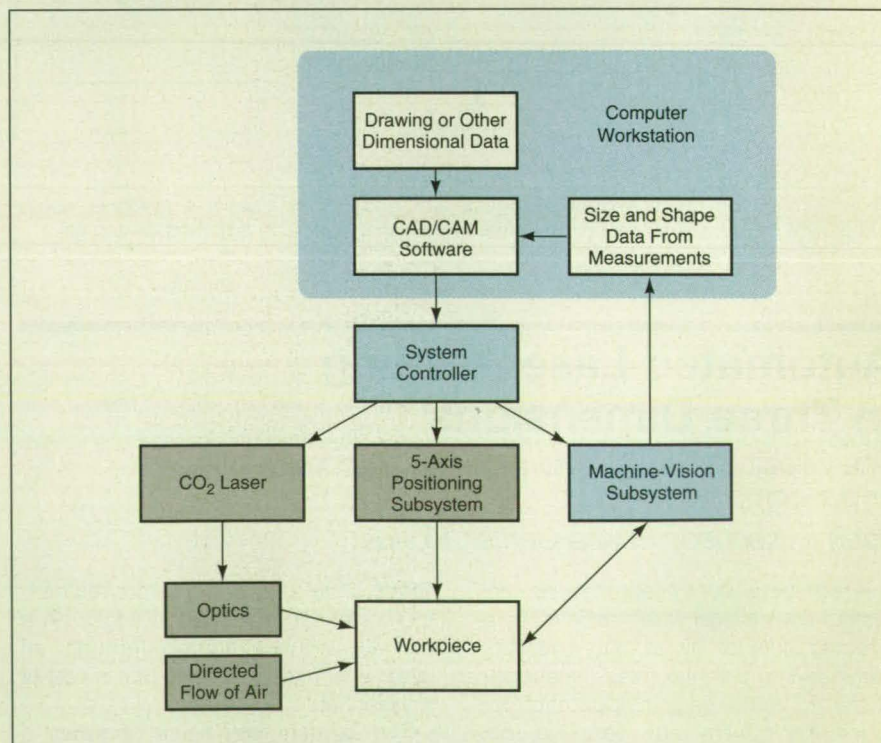
The flow of air is directed at the workpiece by custom-made nozzles and per-

forms three main functions: (1) The flow confines the plasma generated by the laser beam, concentrating its heat on the workpiece for maximum effect. (2) The flowing air reacts exothermally with some of the hot material dislodged from the surface, helping to vaporize the material and thus to ensure a clean operation. (3) The flowing air cools the parts of the workpiece immediately surrounding the plasma, so that the crystalline structure of the workpiece is not adversely affected by the heat; for example, in the case of a silica tile, the cooling air prevents undesired vitrification of the surrounding material.

For safety, the system can be entirely enclosed to prevent the escape of laser energy. No dust is generated during the cutting operation — all material is vaporized; larger solid chips dislodged from the workpiece can easily be removed later.

This work was done by Lisa T. Bird and Mark A. Yvanovich of Lockheed Space Operations and Terry R. Angell, Patricia J. Bishop, Weimin Dai, Robert D. Dobbs, Mingli He, Antonio Minardi, and Bret A. Shelton of the University of Central Florida for Kennedy Space Center. For further information, write in 34 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center; (407) 867-3017. Refer to KSC-11663/4/5.



The **Integrated Machine-Tool System** is an automated system that safely cuts a refractory-material blank to a specified three-dimensional shape.



Algorithm Helps Monitor Engine Operation

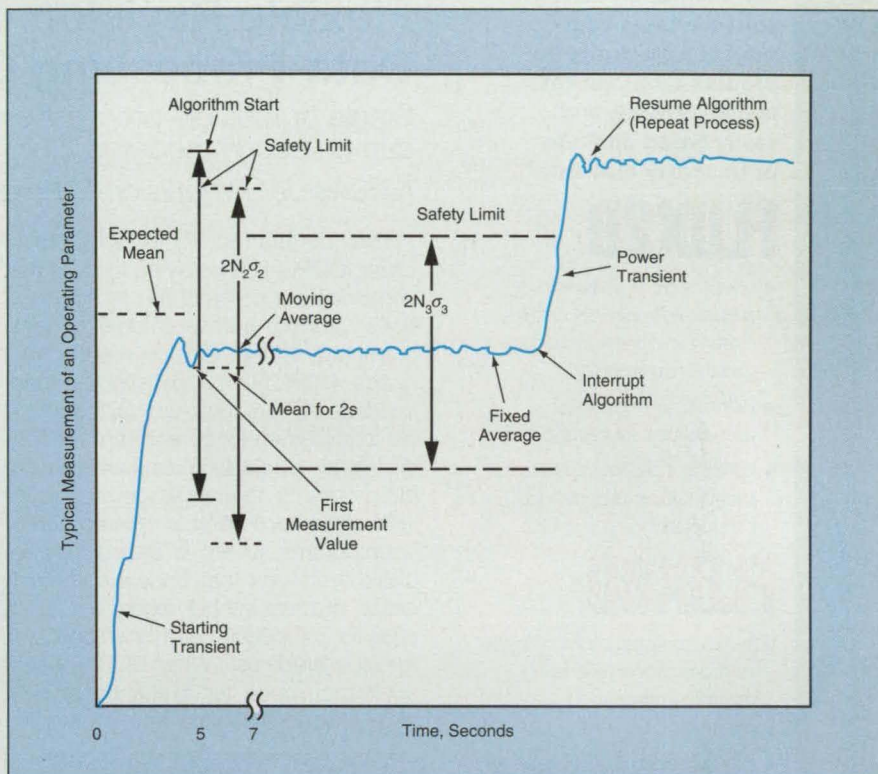
Symptoms of impending failure are detected and processed into shutdown signals.

Marshall Space Flight Center, Alabama

The Real-Time Failure Control (RTFC) algorithm is part of an automated monitoring-and-shutdown system that is being developed to ensure safety and prevent major damage to equipment during ground tests of the main engine of the space shuttle. The monitoring-and-shutdown system includes redundant sensors, controller voting logic circuits, automatic safe-limit logic circuits, and conditional-decision logic circuits, all monitored by human technicians. The basic principles of the monitoring-and-shutdown system may also be applicable to stationary powerplants and other complex machinery systems.

Previous experience showed that selected critical operating parameters can reach their safety limits significant amounts of time after faulty conditions begin to develop. Consequently, shutdown based on reaching these limits can occur too late to prevent serious damage, which could include cascades of failures. The RTFC algorithm was incorporated into the monitoring-and-shutdown system to provide earlier indications of faulty conditions, so that shutdown can be effected in time to prevent further damage.

The RTFC algorithm monitors 24 operating parameters (e.g., pressures, temperatures, and speeds) to detect faults during nominally steady operation and during some transient operating conditions. The algorithm (see figure) provides fault detection in three phases. To avoid perturbation by starting transients, the initiation of the algorithm is delayed until 5 seconds after starting the engine. In the first phase, each of the 24 incoming measurements is immediately compared with the precomputed safety limits of the corresponding operating parameter. These limits are set at the expected mean of the parameter $\pm N_1\sigma_1$, where σ_1 is the expected engine-to-engine standard deviation of the parameter and N_1 is the applicable safety factor (typically, $N_1 \approx 3$). If at least three parameters simultaneously are beyond their limits at any sampling interval, a shutdown signal is generated; otherwise, the algorithm goes on to the second phase.



The RTFC Algorithm computes moving averages of parameter measurements and compares the averages with upper and lower safety limits, which delimit nominal operating ranges of the respective parameters. A fault that warrants safety shutdown is deemed to have occurred when three or more parameters lie outside their nominal operating ranges. The averaging process smoothes out some of the sensor noise.

At the beginning of the second phase, the first measured value of each parameter is designated as a mean value to be used during the first succeeding 2-second interval. A safety band of $\pm N_2\sigma_2$ (where N_2 is a safety factor and σ_2 is a run-to-run standard deviation) is placed around each mean. Thereafter, each incoming measurement is stored and averaged with the four most recent measurements. The five-term moving average value of each parameter is thus updated and checked against safety limits at each sampling interval. The safety limits at each interval are also adjusted to account for transients caused by venting and repressurization of tanks. If the safety limits of three parameters are violated simultaneously at any sampling interval, then a cutoff signal is generated. Moreover, during the first 2-second inter-

val, the standard deviation (σ_3) of each of the 24 parameters is calculated in real time. At the end of the 2 seconds, they are fixed to be used for the duration of the current operating condition. If no safety limits are violated, then the algorithm proceeds to the third phase.

The third phase begins at the end of the first 2-second interval, when the last of the calculated average values of each parameter is released as its mean value for the rest of the operation. Safety limits are set at $N_3\sigma_3$ above and below this mean value. The limits of certain parameters are again adjusted at each time step to account for venting and repressurization transients. The averaging process continues, and these averages are checked against their corresponding limits for violations. If three or more anomalies are indicated simultaneously,

Analyze it. Perfect it. Bring it to market. Fast.

Magsoft's electromagnetic and thermal modelling software takes your project from design to product development quickly, clearly, and easily based on finite or boundary elements.

FLUX2D

- Couples electromagnetic analysis with external circuits, rotating and linear motion, and thermal analysis.
- Flexibility with optional user-defined subroutines.
- Offers fast design modification using multiple user-defined parameters.

FLUX3D

- Makes complex, rapid changes in geometries simple using multiple user-defined parameters.
- Flexible, open postprocessing for the information you need – quickly and clearly.

Get the results you need – the first time, every time.

- For most workstations and PCs.
- Available in English and French.
- On-site training available in English or French.
- Impeccable world-wide product support.



(518) 271-1352
(518) 276-6380 FAX

1223 Peoples Avenue,
Troy, New York 12180 USA

then cutoff is initiated. If not, the algorithm continues operating until a scheduled power transient occurs or until the scheduled cutoff time is reached. At the beginning of a power transient, the algorithm is interrupted for 2 seconds. This process is repeated until the test is completed or a failure occurs.

This work was done by Sherry J. Eckerling, Hagop V. Panossian, Victoria R. Kemp, Mike H. Taniguchi, and Richard L. Nelson of Rockwell International Corporation for **Marshall Space Flight Center**. For further information, write in **72** on the TSP Request Card. MFS-29975

Flexible Revision of Data-Processing Communications

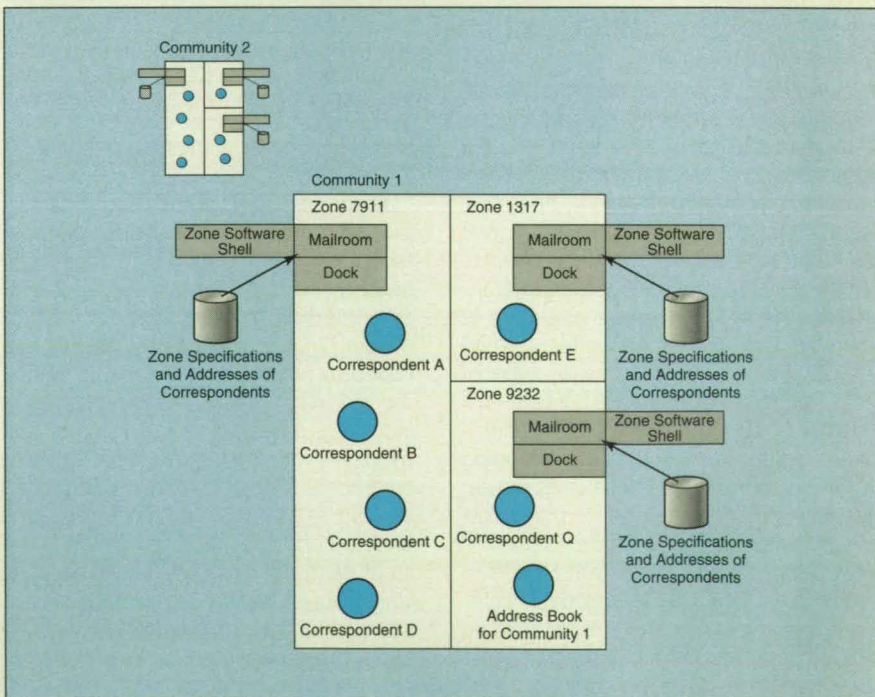
Single or multiple processes and processors can be accommodated.

NASA's Jet Propulsion Laboratory, Pasadena, California

The Distributed Objects Protocol Layer (DOPL) is a software system that implements a protocol for communications among software objects programmed in the C++ computer language. DOPL is an application-program interface (API); in other words, the protocol is implemented by software embedded within application programs and/or subprograms that must communicate with other application programs and/or subprograms. DOPL is based on C++ class definitions that enable communication of data without regard for which specific computer(s) and operating system(s) is (are) in use. When DOPL is used, application code for exchange of data always works the same way whether the

objects involved are parts of the same process or different processes in the same computer or in different computers without modification of the application code. No extension of the C++ language is necessary for use of DOPL.

The basic approach used in DOPL is to add facilities for flow of control signals and data to software objects, so these objects can send messages without knowing where the destination objects reside, and without knowing what communication protocol will be used. DOPL implements a system of asynchronous communication analogous to an efficient postal system (see figure). It enables a single software object to take part in multiple concurrent dialogues. A C++



The Paradigm for DOPL is a postal system. Carrying the postal analogy further, communicating objects (correspondents) can be located within the same zone or different zones, which include the software analogues of mailrooms and are identified by zone numbers analogous to the postal codes used in some countries (e.g., ZIP codes in the United States).

application program thus becomes a collection of objects analogous to correspondents that communicate with each other via the mail.

The main benefit of the use of DOPL is facilitation of change between sequential processing on one computer and simultaneous processing on multiple computers. For example, an application program can be developed in the form of a single executable unit to ease debugging. Then the debugged application program can be divided into parts that can be executed separately or remotely to enhance performance. DOPL also facilitates the opposite transition from multiple to single processing.

As in other methods of implementing parallel processing, the use of DOPL could entail some increase in communication overhead. Furthermore, to incorporate DOPL, C++ programmers must make some basic changes in their approach to the design of software. In the short term, these changes could decrease programmer productivity. However, in the long term, they should increase productivity in that DOPL might facilitate the reuse of software.

This work was done by Scott C. Burleigh of Caltech for NASA's Jet Propulsion Laboratory. For further information, write in 85 on the TSP Request Card. NPO-19099

Software for Managing the Use of Land

This software aids planning to satisfy multiple requirements, including environmental regulations.

John F. Kennedy Space Center, Florida

The Mapping Analysis and Planning System (MAPS) is a menu-driven interactive software system that provides information to aid in land-use planning. The MAPS assists the user in taking account of multiple requirements, including environmental regulations, that can affect the types and locations of facilities and structures.

The MAPS incorporates commercial software packages, including GIS; image-processing; video-capture-and-editing; statistical-data-analysis; three-dimensional graphical, numerical-modeling; and hypertext software; plus software for development of expert systems and neural networks. The software shell for a knowledge-based expert system is being developed to add expert, site-specific knowledge to the fusion-of-data and query processes. The MAPS is undergoing development for use in planning locations for facilities at Kennedy Space Center (KSC); it may also be adaptable to municipal, commercial, and industrial land-use planning.

Solutions to environmental problems often involve complex, interdisciplinary subjects. Decisions must be made with regard to the requirements of such fields as engineering, hydrology, geology, ecology, geography, political science, public health, environmental planning, demography, and sociology. Therefore, the MAPS combines information from a variety of data bases, including digital imagery, GIS thematic layers, master planning files, and legal information derived from the World Wide Web.

Problems that can be addressed with the help of the MAPS include design and location of facilities, monitoring the environment, mitigation of habitat impacts, assessment and documentation of effects on the environment, and many others. The combination of GIS and expert-systems software is expected to result in a software tool that will support and enhance the process of reasoning and judgment regarding compliance with environmental regulations, rather than only automating the process through prescribed computation. This approach will allow managers and engineers access to expert knowledge, covering the highly diversified set of topics associated with a proactive environmental management strategy, easily and directly from their computer terminals.

In its current use at KSC, the MAPS assists in implementing the KSC environmental checklist — a precursor to deciding the locations of facilities at KSC. Depending on a user's responses to questions on the checklist, the MAPS can flag ancillary requirements, offer more detailed information on a topic, or prompt the user for additional data. For example, in the case of a fuel-storage facility, the user would answer "yes" to a question regarding the storage of hazardous material. The user

would then be prompted to state the type and amount of hazardous material. The MAPS would then inform the user of any permits or official actions such as public meetings that may be required in connection with utilization and storage of the particular hazardous material.

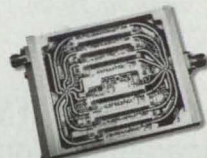
This work was done by Burton R. Summerfield of Kennedy Space Center and C. Ross Hinkle, Carlton R. Hall, and Mark J. Provancha of The Bionetics Corp. For further information, write in 8 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center; (407) 867-3017. Refer to KSC-11719.

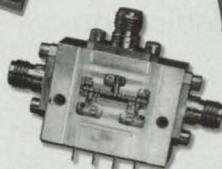
"Custom microwave products"



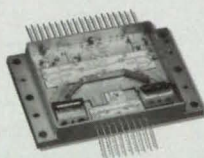
Filters



Switched Filters



Switches



Frequency Converters



Multipliers

REMEC offers a wide range of custom microwave products to satisfy the most difficult avionics systems requirements, where small size, low cost and high reliability are essential.

Contact REMEC Microwave for our new **Capabilities & Products Brochure**.

9404 Chesapeake Drive
San Diego, CA 92123
Ph 619/560.1301
Fax 619.560.0291

REMEC
MICROWAVE DIVISION



Books & Reports

These reports, studies, and handbooks are available from NASA as Technical Support Packages (TSPs) when a Request Card number is cited; otherwise they are available from the NASA Center for Aerospace Information.



Machinery

Thermal Strap Increases Cryocooling Efficiency

A report discusses a concept for decreasing the compressor power consumed by a spacecraft mechanical cryocooler that provides 0.5 W of refrigeration at a temperature of 61 K at the tip of a cold finger. The concept involves connecting a thermal strap between (1) a radiator or other heat sink at an intermediate temperature (e.g., 150 K) and (2) a stiffening ring that is located on the cold finger about one-third the way from the base to the tip and that attains a temperature of about 250 K during normal operation. Depending upon the specific design, the electrical power consumed by the mechanical cryocooler could be reduced by as much as half.

This work was done by Ronald G. Ross, Jr., and Dean L. Johnson of Caltech, and Kenneth E. Green of Loral for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "Cryocooler Coldfinger Heat Interceptor," **write in 71** on the TSP Request Card. NPO-19395

Reversible Nut With Engagement Indication

A document describes a nut that allows a fastener to be inserted or removed from either side by simply sliding the fastener in or out. Detents on each face of the nut, when pushed in, ensure positive engagement of the threads. This is followed by conventional clockwise turning to lock and counterclockwise turning to unlock the nut. The detents, when viewed, will show whether the nut is in a positive lock.

This work was done by Jay M. Wright of **Johnson Space Center**. For further information, **write in 13** on the TSP Request Card.

This invention has been patented by NASA (U.S. Patent No. 5,118,237). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center; (713) 483-4871. Refer to MSC-21799.

Control Algorithms for Kinematically Redundant Manipulators

A report presents improved algorithms for controlling kinematically redundant robotic manipulators. The improved algorithms described in the report produce a unique configuration for each end-effector location. Furthermore, they generally produce configurations in which there is no interference between a robot boom and the payload or base structures. The report presents a comparison between various other robot-kinematic algorithms and the improved algorithms.

This work was done by David R. Wegner of **McDonnell Douglas for Johnson Space Center**. To obtain a copy of the report, "An End Effector Opposing Inverse Transformation Function (ITF) and Rate Law for the Space Station Remote Manipulator System (SSRMS)," **write in 12** on the TSP Request Card. MSC-22313.

Computed Hydrogen-Flow Splits in a Rocket Engine

A report presents a study of flows of hydrogen (as both a coolant and a fuel) along various paths in the fuel injector of a rocket engine. The study included computational simulations of the flows. The computer program used in the study simultaneously solves for the flows along the various flow paths and determines the coolant pressure and hot-gas pressures in the injector. Injectors of various geometries can be modeled. The computer model implements equations of one-dimensional, steady, incompressible flow, with a standard correlation for the friction factor as a function of the Reynolds Number and surface roughness.

This work was done by W. Dennis Romine of **Rockwell International Corp. for Marshall Space Flight Center**. To obtain a copy of the report, "Computer Model For Determining SSME Main Injector Coolant Flow Splits," **write in 17** on the TSP Request Card. MFS-30024



Physical Sciences

Pressure and Thermal Modeling of Rocket Launches

A report presents a mathematical model for use in designing a rocket-launching stand. The model predicts the pressure and thermal environment, as well as thermal responses of structures to impinging rocket-exhaust plumes. The model enables a relatively inexperienced analyst to determine the time-varying distributions and absolute levels of pressure and heat loads on the structures. A submodel of radiant heating has been incorporated to determine the radiant heat loads to the structure due to the high-temperature shock layer upstream of each surface in question.

This work was done by Sheldon D. Smith, Brian L. Myruski, Richard C. Farmer, and Jon A. Freeman of **SECA, Inc., for Marshall Space Flight Center**. To obtain a copy of the report, "Model Development for Exhaust Plume Effects on Launch Stand Design - PLIMP/LSD," **write in 87** on the TSP Request Card. MFS-26283

Field of View of a Spacecraft Antenna: Analysis and Software

A report summarizes a computational analysis of the field of view of a rotating elliptical-cross-section parabolic-reflector antenna for the SeaWinds spacecraft. Issues considered in the analysis include blockage and diffraction by other objects near the antenna, related concerns about electromagnetic interference and electromagnetic compatibility, and how far and in what configuration other objects should be positioned with respect to the antenna to achieve the required performance. The analysis was conducted by use of a modified version of a computer code called "Apatch," and ancillary software, with all of which the reader is apparently assumed to be familiar.

This work was done by Te-Kao Wu of Caltech and R. Kipp and S. W. Lee of

DEMACO for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "Spacecraft Antenna Field of View Analysis and Computer Code," **write in 82** on the TSP Request Card. NPO-19549



Electronic Systems

Digital Controller for Laser-Beam-Steering Subsystem

A report presents additional information about the proposed apparatus described in "Beam-Steering Subsystem for Laser Communication" (NPO-19069), *NASA Tech Briefs*, Vol. 19, No. 6, page 32. The report discusses the design of the digital beam-steering control subsystem and, in particular, that part of the design that pertains to digital compensation for the frequency response of the steering mirror. Preliminary results of computer simulations and experiments suggest that the system will work as expected.

This work was done by Homayoon Ansari of Caltech for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "Discrete-Time Design of Tracking Control Loop for Optical Communications," **write in 41** on the TSP Request Card. NPO-19193

More About Beam-Steering Subsystem for Laser Communication

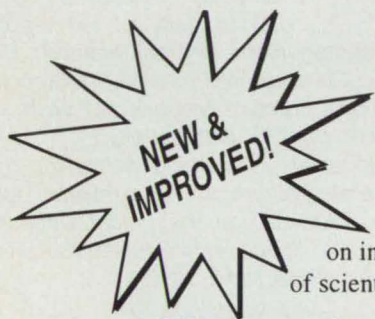
Two reports present additional information about a developmental beam-steering subsystem of a laser-communication system. Aspects of this subsystem have been described previously in *NASA Tech Briefs*; namely, "Beam-Steering Subsystem for Laser Communication" (NPO-19069), Vol. 19, No. 6, page 32. See also the brief just preceding this one (NPO-19193). The two reports reiterate the basic principles of operation of the beam-steering subsystem and of the laser-communication system as a whole. The reports also present some of the details of the optical and mechanical design of a prototype of the subsystem, called the Optical Communication Demonstrator.

One of the notable features of the design is the use of a single-mode optical fiber to deliver the outgoing modulated laser beam to the telescope; this simplifies both the optical and mechanical aspects of the design, enables the design of a laser transmitter as a module separate from the telescope, and simplifies the thermal-control problem by making it possible to locate the transmitter away from the telescope.

This work was done by Norman A. Page, Chien-Chu Chen, Hamid Hemmati, and James R. Lesh of Caltech for **NASA's Jet Propulsion Laboratory**. To obtain copies of the reports, "Overview of the Optical Communications Demonstrator" and "Design of the Optical Communication Demonstrator Instrument Optical System," **write in 50** on the TSP Request Card. NPO-19381

Digital Controller for Laser-Beam-Steering Subsystem: Part 2

A report presents additional information about a laser-beam-steering apparatus described in previous articles in *NASA Tech Briefs*: see the two preced-



NEW features!

- 64-bit support for R8000 machines
- system enhancements, including an improved scripts interface; a new visual "drag & drop" interface; new widgets for module control panels; editable groups
- new modules for vector data, geometry, annotation, data analysis; "NAG" modules based on the NAG Graphics Library and NAG numerical libraries
- completely revised, updated documentation

Get to know the new IRIS Explorer

The latest version of the complete object-oriented visualization package for scientists and engineers displaying and analyzing complex data

The Numerical Algorithms Group proudly announces IRIS Explorer™ release 3.

Designed for top-quality performance in distributed processing environments or on individual workstations, this comprehensive package is the visualization software choice of scientists, engineers and other business professionals worldwide.

Varied applications!

IRIS Explorer is a valuable problem-solving tool for:

- computational fluid dynamics
- mechanical, electrical engineering
- aerospace engineering
- geology
- physics
- biochemistry
- medical research
- atmospheric research
- architecture
- financial modeling
- and many more applications!

NEW platforms!

- available now for SGI, SUN SPARC (OS 4.1.x and Solaris 2.x), IBM RS/6000, Cray YMP and HP 9000/700; available soon for DEC Alpha (OSF1)

For more information about the **NEW & IMPROVED IRIS Explorer release 3** and other products for software development and research, contact NAG at the numbers below, or e-mail info-ntb@nag.com.

NUMERICAL ALGORITHMS GROUP, INC.

ntbad

1400 Opus Place, Suite 200 • Downers Grove, IL 60515-5702 • 708.971.2337 • fax 708.971.2706

NAG®

ing briefs (NPO-19193 and NPO-19381) and the reference therein. The report that is the subject of this article reiterates the basic principles of operation of the beam-steering subsystem, with emphasis on the modes of operation, basic design concepts, and initial experiments on a partial prototype of the apparatus.

This work was done by Homayoon Ansari and LeeAnn Voisinnet of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "A CCD-Based Control Loop for Precision Beam Pointing," write in 18 on the TSP Request Card. NPO-19441

Interface Circuit Board for Space-Shuttle Communications

A report describes an interface electronic circuit that was developed to enable ground controllers to send commands and data via Ku-band radio uplink to multiple circuits connected to a standard IEEE-488 general-purpose interface bus in the space shuttle. At the time of submission of the report, this interface circuit was destined to replace a nonstandard interface circuit then used aboard the space shuttle. The design of this circuit would extend the data-throughput capability of the communication system of the space shuttle by use of a 128-Kb/s Ku-band uplink that would bypass the main space shuttle computers, making 90 percent of the Ku band available for commanding payloads and for serving experiment modules, printers, plotters, and other equipment. The integrity is preserved by use of a Reed-Solomon error-correction algorithm.

This work was done by Brett T. Parrish of Johnson Space Center. To obtain a copy of the report, "Shuttle Communications Interface Board," write in 43 on the TSP Request Card. MSC-22367

Automated Planning of Spacecraft Telecommunications

A computer program known as SWIFT (Software for What-If Telecommunications) is a user-friendly, modular, portable, window-based software tool. SWIFT accelerates and automates planning of antenna usage for spacecraft telecommunication systems and enables predictions of the performances of such systems. It has been estimat-

ed that the return on investment from the use of SWIFT will be tenfold in terms of work years and even greater in terms of dollars.

This work was done by John R. Veregge, Ursula M. Schwuttke, Monica B. Rivera, and Vickere B. Murphy of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "An Automated Approach for Planning Spacecraft Telecommunications," write in 52 on the TSP Request Card. NPO-19476

Artifacts of Spectral Analysis of Instrument Readings

A report presents an experimental and theoretical study of some of the artifacts introduced by processing the outputs of two nominally identical low-frequency-reading instruments — in particular, high-sensitivity servo-accelerometers mounted together and operating, in conjunction with signal-conditioning circuits, as seismometers. The processing in question involved analog-to-digital conversion with anti-aliasing filtering, followed by digital processing that included frequency weighting (in effect, frequency filtering) and computation of different measures of power spectral density (PSD).

This work was done by James H. Wise of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "Processing Effects on 1/f Noise and Other Data Artifacts," write in 51 on the TSP Request Card. NPO-19499

Neural-Network Controller for Vibration Suppression

A neural-network-based adaptive-control system is proposed for vibration suppression of flexible space structures. The controller features a three-layer neural network and utilizes output feedback. Measurements are generated by the various sensors on the structure. A feed forward path may also be included to speed up response in the case that the plant exhibits predominantly linear dynamic behavior.

The control system described in this report is applicable to single-input single-output systems. This work has been extended to multiple-input multiple-output systems as well.

This work was done by Dhemitrios Boussalis and Shyh Jong Wang of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the

report, "Neural Network Vibration Control Based on Output Feedback," write in 38 on the TSP Request Card. NPO-19138



Mechanics

Adaptive Finite-Element Computation in Fracture Mechanics

A report discusses recent progress in the use of solution-adaptive finite-element computational methods to solve two-dimensional problems in linear elastic fracture mechanics. A solution-adaptive method is described and used to compute stress-intensity factors of two-dimensional cracks with predetermined locations and loading conditions. The method is tested on demonstration problems and shown to yield results in reasonable agreement with those computed by an alternative theoretical method. The method is also shown to be extensible to three-dimensional problems.

This work was done by J. B. Min of Marshall Space Flight Center, J. M. Bass of Computational Mechanics Co., and L. W. Spradley of ResearchSouth, Inc. To obtain a copy of the report, "Adaptive Finite Element Methods For Two-Dimensional Problems In Computational Fracture Mechanics," write in 30 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-26314.

Attitude Control for the Cassini Spacecraft

A report discusses design concepts for attitude control of the Cassini spacecraft, which is scheduled to be launched in 1997 and to arrive at Saturn in 2004. The mission requires accurate pointing and complex maneuvering of the spacecraft, which comprises a Saturn orbiter and a probe that will be detached from the orbiter and launched into the atmosphere of Titan (one of the moons of Saturn). The control architecture described in the report is hierarchical, modular, and object-oriented.

This work was done by Edward C. Wong, William G. Breckenridge, Robert Rasmussen, and Douglas E. Bernard of

Caltech for **NASA's Jet Propulsion Laboratory**. To obtain a copy of the report, "An Attitude Control Design for the Cassini Spacecraft," **write in 100** on the TSP Request Card. NPO-19674

Analytical Model for Fluid Dynamics in a Microgravity Environment

A report presents an analytical approximation methodology for providing coupled fluid-flow, heat, and mass-transfer equations in a microgravity environment. Experimental engineering estimates accurate to within a factor of 2 can be made quickly and easily, thus eliminating the need for time-consuming and costly numerical modeling. Any proposed experiment can be reviewed to see how it would perform in a microgravity environment. The fluid-flow, heat, and mass-transport rates can be used to optimize performance of an experiment within the microgravity environment. The model can be applied in a commercial setting for preliminary design of low-Grashoff/Rayleigh-number experiments. The effects of axial and transverse magnetic fields are also included, which apply to terrestrial processes if the Hartmann number is large.

This work was done by Robert J. Naumann of The University of Alabama in Huntsville for **Marshall Space Flight Center**. To obtain a copy of the report, "Studies for USML-1: Glovebox Demonstrations," **write in 99** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-26355.



Materials

Study of Rocket-Engine Joints Bonded by Ni/Cu/NARloy-Z

A report describes a study of those joints in the main combustion chamber of the main engine of the space shuttle that are bonded by use of electrodeposited nickel on electrodeposited copper on NARloy-Z. The primary concern in this study was to understand interrelationships among stresses in the joints, the strengths of the joints, and variations of parameters of the joints, with a view toward developing process controls to ensure strong joints free of defects. These relationships were evaluated via finite-element computations of stresses, with emphasis on the regions closest to the bond terminations and interfaces, where failures are generally thought to occur. The results of the study appear to be applicable to any similarly bonded joints that can be characterized by the parameters used and assumptions made in this study.

This work was done by J. B. Min and K. L. Spanyer of **Marshall Space Flight Center**. To obtain a copy of the report, "A Study on Strength Evaluations of EDNi/EDCu/NARloy-Z Bonded Joints," **write in 97** on the TSP Request Card. MFS-28957

(continued on next page)

LUMITEX...woven backlighting



- **Long-Life** – up to 100,000 hours
- **Low Power** – from 2 to 5 volts, 20mA to 1 Amp-DC
- **No Heat** – extends LCD temperature range
- **Easy to Use** – requires little or no maintenance
- **Low Cost** – economical to buy and operate

Call, FAX or write:

Phone: 1-800-969-5483

FAX: (216) 243-8402

© 1994 Lumitex, Inc., all rights reserved



Lumitex, Inc.

Creators of Woven Light

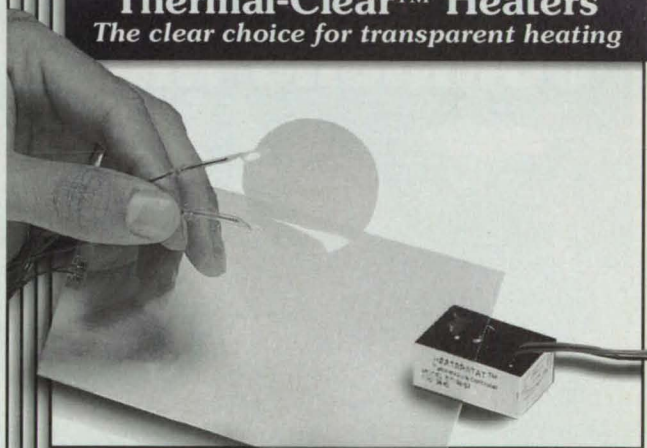
8443 Dow Circle
Strongsville, OH 44136

9-1

For More Information Write In No. 432

Thermal-Clear™ Heaters

The clear choice for transparent heating



- Optical grade mylar with fine wire element for shine-through heating • 82% minimum light transmission
- Rectangular, round, and irregular shapes to 11" x 22"
 - Optional temperature sensors & controllers

Extend the operating range of LCD's & fluorescent tubes

- Portable computers & scanners • Incubator covers
- Microscope stages • Aircraft displays • Medical devices • Outdoor security equipment • Faceplates

MINCO PRODUCTS, INC.

7300 Commerce Lane • Minneapolis, MN 55432-3177 U.S.A.

Telephone: (612) 571-3121 • FAX: (612) 571-0927

(continued from previous page)

Improved Silicon Nitride for Advanced Heat Engines

A report summarizes the results of four years of research directed toward increasing the strength and reliability of injection-molded silicon nitride parts for advanced heat engines. The research involved extensive experimental studies of formulations, additives, processes, and the resultant chemical, physical, and thermomechanical properties. Experiments were designed and performed to identify and optimize critical processing parameters and material variables. Physical properties over a wide temperature range and microstructures were used to characterize parameter variables. Exploratory experiments on injection molding of turbocharger rotors were conducted, and these results showed promise of processing improvements.

This work was done by Harry C. Yeh and Ho T. Fang of Allied-Signal Aerospace Co. for **Lewis Research Center**. For further information, **write in 29** on the TSP Request Card. LEW-15843



Manufacturing/Fabrication

Parameters for Welding Aluminum/Lithium Alloys

A report discusses the parameters that must be controlled to properly weld aluminum/lithium alloys. Welds in these alloys are highly susceptible to oxidation and to formation of lines of hydrogen bubbles. To prevent these undesired effects, it is necessary to keep oxygen and water vapor away from the weld site on a workpiece by providing both backside and front-side inert-gas shielding during the welding process. The report describes experiments that were conducted to determine the gas-shielding parameters that yield acceptable welds.

This work was done by Robert L. Gallagher of Martin Marietta for **Marshall Space Flight Center**. To obtain a copy of the report, "Gas Backside Shielding Parameters and Methods for the Welding of Aluminum Lithium Alloys," **write in 78** on the TSP Request Card.

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to Martin Marietta Corp.

Inquiries concerning licenses for its commercial development should be addressed to:

Martin Marietta Corp.

P. O. Box 29304

New Orleans, LA 70189

Refer to MFS-28894, volume and number of this NASA Tech Briefs issue, and the page number.

Lightweight Composite Intertank Structure

A report presents the results of a study for a proposed lightweight composite material alternative to the present semimonocoque aluminum intertank structure (the mechanical interface between the fuel and oxidizer tanks) for advanced launch vehicles. The proposed structure would be an integrated assembly of sandwich panels made of laminated epoxy-matrix/carbon-fiber skins, and aluminum honeycomb core. The study serves as an example of the "concurrent engineering" approach, in which design, analysis, and manufacturing are treated as an integrated process.

This work was done by Greg V. Mehle of Martin Marietta Astronautics for **Marshall Space Flight Center**. To obtain a copy of the report, "Lightweight Composite Intertank Structure," **write in 44** on the TSP Request Card. MFS-31073

Foil Patches Seal Small Vacuum Leaks

A report discloses a technique to patch holes in nickel-alloy rocket-engine nozzle parts prior to vacuum brazing. The technique involves lightly spot-welding a nickel foil 0.002 in. (0.05 mm) thick over the hole to be patched, then spot-welding a corrosion-resistant steel foil of the same thickness over the nickel foil. Once the patches are subject to the pressure and temperature of the vacuum brazing, the nickel foil diffuses to bond with the nickel-alloy nozzle, thereby making a vacuum-tight seal.

This work was done by Kirk W. Spiegel and David W. Reed of Rockwell International Corp. for **Marshall Space Flight Center**. To obtain a copy of the report, "Foil Patch Repair of SSME Nozzle Jackets," **write in 86** on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-30047.

(continued on page 99)

Solutions that Resist Filter Last Ooze Bubble



Filtros® porous ceramics offer superior design solutions for filtering, diffusing, fluidizing, venting, dispersing, and any other application

requiring controlled porosity and permeability. They're

tough, consistent and available in a wide range of shapes and pore sizes for your special needs. And since 1913, Filtros has led the way in porous ceramics innovation. Need information on how ceramics can solve your design problem?

Call Dick at 1-800-633-2143. Ferro Corporation, Filtros Plant, P.O. Box 389, East Rochester, NY 14445.

Partners in Quality





Electronic Components and Circuits

Data Base on Cables and Connectors

A report describes the Connector Adapter Cable Information Data Base (CONNAID) computer program, which manages a data base containing necessary information concerning electrical connectors, breakout boxes, adapter cables, backshells, and pertinent torque specifications for an engineering project. A connector number can be entered, and the computer will provide compatible and mating connector information and specification references. The correct adapter cable number is presented along with breakout box configuration options, installation instructions, and diagrams.

This work was done by Arlen R. Bowen and John D. Oliver of McDonnell Douglas Corp. for Kennedy Space Center. To obtain a copy of the report, "CONNAID (Connector Adapter Cable Information Data Base)," write in 102 on the TSP Request Card.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Kennedy Space Center; (407) 867-3017. Refer to KSC-11762.

Effect of Clock Mode on Radiation Hardness of an ADC

A report discusses techniques for testing and evaluating the effects of total dosages of ionizing radiation on the performances of high-resolution successive-approximation analog-to-digital converters (ADCs), without having to test each individual bit or transition. The basic thrust of this discussion is to reduce the cost of testing by reducing tests to a few critical parametric measurements, from which one can determine approximate radiation failure levels that will provide good approximations of the responses of the converters for purpose of total-dose-radiation evaluations.

This work was done by Choon I. Lee, Bernie G. Rax, and Allan H. Johnston of Caltech for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "Hardness Assurance and Testing Techniques for High Resolution (12- to 16-bit) Analog-to-Digital Converters," write in 11 on the TSP Request Card. NPO-19697



Mathematics and Information Sciences

Fault-Tolerant Control for a Robotic Inspection System

A report describes the first phase of a continuing program of research on a fault-tolerant control subsystem of a telerobotic visual-inspection system. The ultimate goal of the program is to develop a robotic system for remotely controlled visual inspection of structures in outer space. The innovation of this research is a comprehensive strategy that integrates system-level tolerance of hardware and software faults with task-level handling of uncertainties and unexpected events.

This work was done by Kam Sing Tso of SoHaR, Inc., for NASA's Jet Propulsion Laboratory. To obtain a copy of the report, "A Fault Tolerant Intelligent Robotic Control System," write in 156 on the TSP Request Card. NPO-30012

**YOUR COMPETITORS DO BUSINESS ON
A GLOBAL LEVEL..... DO YOU?**

PERINORM

Now you can research over 300,000 specifications & draft standards from dozens of issuing organizations including BSI, AFNOR, DIN, JIS, ASTM, IEEE, UL, ANSI, ISO & IEC.

Perinorm is a bibliographic database which allows you

to search standards and specifications necessary for doing business in a global marketplace. Perinorm helps you improve efficiency and avoid costly mistakes.

Further information and demo diskettes available.

- * Contains over 300,000 records
- * Multilingual (English, French & German)
- * Contains records on draft standards
- * Official product of AFNOR, DIN & BSI
- * Updated monthly with a new CD-ROM
- * Cross references equivalent standards
- * Easy to use menu driven screens
- * Much lower cost than full text



Available now from:

DECO

15210 Stagg St.

Van Nuys, CA 91405-1092

FAX: 818-782-2374

1-800-MIL-SPEC

For More Information Write In No. 446



DOCUMENT ENGINEERING CO., INC.

Suppliers of Technical Standards & Documents

With our huge inventory of hard copy standards in stock, orders are shipped the same day & fax orders are transmitted in about an hour.

This is a partial listing of the documents we carry:

U.S. INDUSTRY STANDARDS	FOREIGN/INTERNATIONAL	GOVERNMENT SPECIFICATIONS & STANDARDS
-AIA(NAS)	-IEC	-MIL Spec
-ATA	-ISO	-MIL Standards
-SAE(AMS)	-AECMA	-MIL Handbooks
-NAS Sets	-SBAC	-MIL Bulletins
		-AN/AND/MS Standards
		-QPL's

**We carry dozens of other publications
in stock ready to ship to you today!**

DECO

15210 Stagg Street

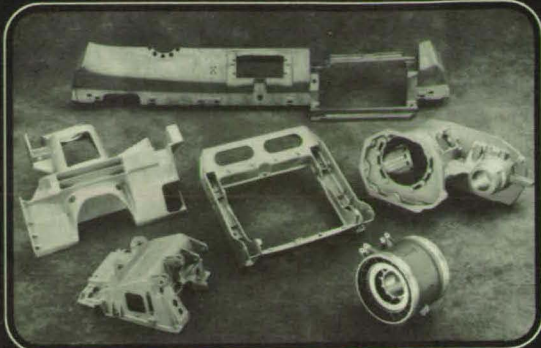
Van Nuys, CA 91405-1092

(818) 782-1010

FAX: (818) 782-2374

1-800-MIL-SPEC Serving the Aerospace Industry Since 1958

CASTING TECHNOLOGY ALUMINUM/MAGNESIUM



Prototyping Pre-production Production
Sand, Investocure®, Gravity, Die and Squeeze Processes

- **LOW AND HIGH** volume J.I.T. deliveries/S.P.C. controlled
 - **HIGH INTEGRITY** Automotive, Aerospace, Commercial and Government castings
 - **ADVANCE QUALITY SYSTEM** Compliance with ISO-9000 International Aerospace, and all leading commercial and government specs.
 - **CAD/CAM DESIGN** thru completed assemblies
 - **FULL IN-HOUSE** laboratory & testing facilities
- FOR QUOTES FAX BLUEPRINTS TO 216-475-6611**

TAC THOMPSON
CASTING CO., INC.

4860 Chaincraft Rd.
Cleveland, Ohio 44125
Phone: (216) 581-9200
FAX: (216) 475-6611

For More Information Write In No. 434

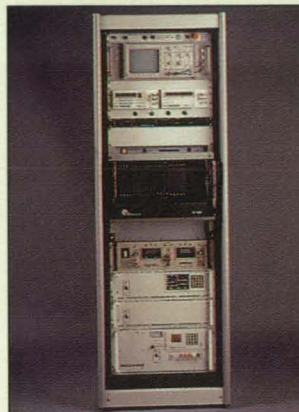
NASTRAN® and FEMAP®

Unlimited Problem Size
Windows Interface
Pre/Post Processing
DMAP
DXF and IGES Import
Linear Statics
Normal Nodes
Buckling
Heat transfer Analysis
Nonlinear Analysis
Aeroelasticity
Dynamic Response
Cyclic Symmetry
And Much More For Only
\$3,995

MACRO Engineering
100 McAdoo Dr., Madison, AL 35758
(205) 461-7090 fax 772-9847

For More Information Write In No. 435

New on the Market



Racal Instruments Inc., Irvine, CA, has introduced the Freedom Series **automatic test equipment system** that features custom-designed and assembled components. The system design, configuration, and documentation are automated via engineering software. The user selects all components, from test equipment to cables, racks, and slides, and the system is then configured from available instruments.

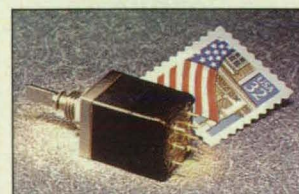
For More Information Write In No. 700

VideoLabs Inc., Minneapolis, MN, has introduced VideoShot, a palm-sized, standalone **frame grabber** that plugs into the parallel port of a notebook or desktop PC, or operates on batteries. It captures and images at 640 x 480 resolution in 16 million colors in 1/30th of a second. Video input is accepted from any video source, such as a video camera or VCR. The device is compatible with all image-processing software.

For More Information Write In No. 701

The VAT Series 69 **variable leak valve** from VAT Inc., Woburn, MA, features a hydraulically actuated mechanism that permits vacuum-tight sealing from UHV to 10 BAR. The gas inlet valve features a stainless steel body with gold plating, an Inconel® sealing surface, and no internal elastomers. It provides repeatable gas flow settings by micrometer adjustment.

For More Information Write In No. 702



Janco Corp., Burbank, CA, offers PC-board-mounted **microminiature rotary switches** with integral potentiometers for switching problems where small size and enhanced environmental operating specifications are required. The 1/2"-square sealed switches and switch/potentiometer combinations feature rotary stop-strength of 6 inch-pounds minimum.

For More Information Write In No. 703

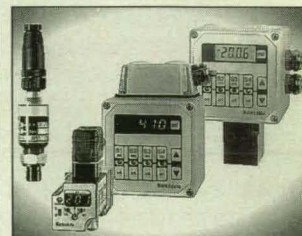
The SuperDamp™ self-leveling **vibration isolator** from Melles Griot, Irvine, CA, provides isolation from horizontal and vertical vibration in applications such as interferometry, holography, and nanopositioning. The liquid-free isolator is available in freestanding and support frame versions, and automatically compensates for table-top load changes.

For More Information Write In No. 704



Omega Engineering, Stamford, CT, has released the OMB-Multiscan-1200 **temperature/voltage interface** unit that features channel-to-channel isolation for temperature and voltage measurements. Inputs can be scanned at a rate of 147 channels per second with available expansion to 744 channels. Standard memory of 256 Kb is expandable to 8 Mb. Windows-based software is included.

For More Information Write In No. 705



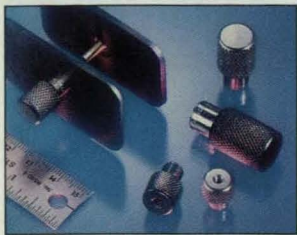
Barksdale Inc., Los Angeles, CA, has introduced five solid state electronic **pressure switches** that range from single-setting, single-input units to four-setting, dual-input versions. The switches offer operating pressure ranges from vacuum to 12,000 psi and feature ambient temperature compensation, repeatability of +0.1%, and RS 232 or RS 485 serial ports for computer interface.

For More Information Write In No. 706

OmniCAD, Jackson, MI, offers a **CAD conversion service** that produces CAD files from manual drawings, including scanning and vectorization, digitizing, and CAD library creation using design, drafting, and modeling software. Design engineers in FEA analysis, mechanical systems, electrical/electronics systems, and hydraulic/pneumatic systems convert drawings into any CAD format on any disk size, on tape, or downloaded through a modem or CD-ROM. Manual redrawing also is available.

For More Information Write In No. 707

New on the Market



Southco Inc., Concordville, PA, has introduced the Captive Nut **fastening hardware** for use where access for installation behind a panel is limited, or where vertical panels must be held in place before thread alignment. The hardware is used in electronics equipment and computers, and eliminates equipment damage due to misplaced hardware. It becomes an integral part when pressed into the removable outer panel or assembly, and can be mated with externally threaded hardware.

For More Information Write In No. 708



The XCXL **pressure transducers** from Data Instruments Inc., Acton, MA, are manufactured in 4" and 10" of water ranges and are PC-mountable. Designed for low-pressure applications in medical and instrumentation areas, the micromachined devices feature excitation of 4 to 16 volts, with linearities of 1% and 0.5% for both ranges.

For More Information Write In No. 709

The RX-800 series **data recorders** from TEAC America Inc., Montebello, CA, offer computer control via Windows-based QuikVu RX™ proprietary software that allows real-time data monitoring on a PC or laptop. Users can set triggers, preview information, capture data samples, make preliminary analyses, and monitor data while recording. The units can record 16 to 32 channels using Hi-8mm tape technology, and are suited for acoustical and vibration data recording in aerospace/defense, military, and instrumentation industries.

For More Information Write In No. 710

The ATLAS **automated data storage system** from EDAC Systems Inc., Fredericksburg, VA, consists of a data recorder or tape drive, data interface, a robot, and system software. The system archives 50 GB to 1000 TB of data on a variety of tape drives and data recorders using storage management software. An X-Y robot, tape stacker, or artificially intelligent arm (Archie) robot provide data retrieval and storage, and are available in an unlimited number of storage capacity options.

For More Information Write In No. 712

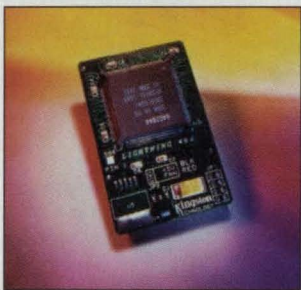
ACR Systems Inc., Surrey, BC, Canada, has introduced the PowerWatch **power quality monitor** that plugs into a wall outlet and activates a visual alarm to identify power surges, sags, impulses, dropouts, outages, and frequency variations in AC power systems. The information is recorded for analysis on an IBM-compatible PC. The unit protects electronic equipment from power loss damage, prevents system downtime, and protects the integrity of electronic data.

For More Information Write In No. 714



Science Accessories, Columbia, MD, has announced the Freepoint 3D™ portable **3D digitizers** that acquire 3D information from objects to create databases. A handheld probe contacting the object emits sonic waves which are received by three microphones. The unit measures the time it takes the sound to reach the receivers and converts it into x, y, and z data coordinates. Available in three size configurations, the digitizers are used for rapid prototyping, design, modeling, measuring, and failure analysis.

For More Information Write In No. 711



Kingston Technology Corp., Fountain Valley, CA, has released the Lightning 486, a 486 66 MHz **processor upgrade** for most 386/DX computer systems that increases performance up to five times that of the original system. An IBM Blue Lightning 486 33/66 MHz clock-doubled processor is combined with an integrated 16 Kb internal cache and a write-back cache scheme. It allows computer clock speed to be doubled or tripled, and installs into the existing processor socket of the system after the original CPU is removed.

For More Information Write In No. 713

PRECISION
Slides
X-Y & ROTARY
Tables

Get to the Point
Get the Catalog Free
CHOOSE FROM OVER 756 MODELS

Call 800-642-6446 (Except NYS), Ask for Catalog M

USES Scanning or positioning of a probe, sensor, cutter or transducer. Also remote indexing, feeding or dispensing. **FEATURES** Compact, durable and moderate price. Easy to program motor controllers. Modular design for easy XYZ theta construction. **SPECS** 7 widths: 1½" to 9". Lengths: 3" to 10 ft. Maximum payload 400 pounds. Components or complete systems; motors and controllers.

VELMEX, INC.

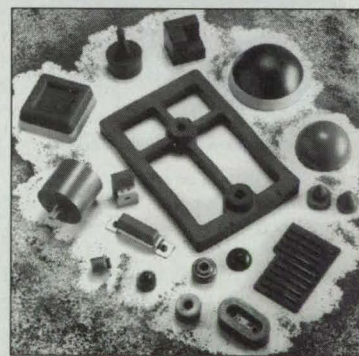
P.O. Box 38 • Bloomfield, NY 14443 (in NYS) Call 716-657-6151

For More Information Write In No. 436

Shock and Vibration Damping Up to 94%

Sorbothane® patented visco-elastic material absorbs and dissipates unwanted energy and outperforms rubber and other materials by providing:

- Impact Absorption
- Vibration Isolation
- Sound Damping
- Excellent Memory
- Low Creep
- Quick & Cost-Effective Custom Molding



Sorbothane®—the solution to all your energy dissipation needs.

Call today for a free brochure and prototype sample.
216/678-9444

Sorbothane Inc.

2144 State Route 59, PO Box 178, Kent, Ohio 44240
216/678-9444 FAX 216/678-1303

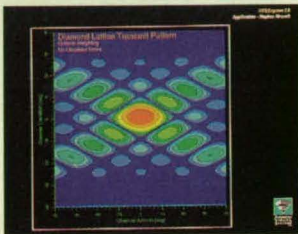
Product of the Month



SolidWorks Corp., Concord, MA, has introduced what it calls the first **solid modeling mechanical design software** developed specifically for Microsoft Windows. SolidWorks 95 includes all Windows features, in addition to a DesignBrowser™ dual-mode interface; real-time shaping of parts with visual feedback previewing; right mouse button control; and feature construction wizards.

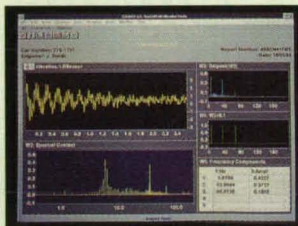
The program's 3D-centric design process incorporates a solid model used as a master for rapidly producing drawings and performing other functions such as finite-element analysis and numerical control programming. The RapidDraft™ feature allows drawings to be created directly from a solid model. The cost is \$3995.

For More Information Write In No. 730



Advanced Visual Systems, Waltham, MA, has introduced AVS/Express 2.0, **3D visualization software** that converts any data into 3D visual representations in new or existing Windows and UNIX applications. Users can analyze large data sets through a visual interface. Components may be assembled from GUI, graphics, and visualization libraries using a drag-and-drop interface. Prices start at \$18,000.

For More Information Write In No. 731



DADISP 4.0 **data analysis software** from DSP Development Corp., Cambridge, MA, collects, analyzes, and displays scientific and technical data. Program enhancements include an interprogram communications protocol, a new programming language, on-line documentation, and improved printing capabilities. The cost is \$1895 for PCs; \$2995 for workstations.

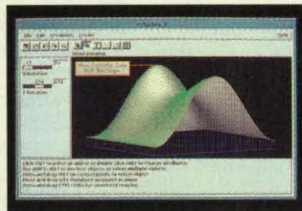
For More Information Write In No. 732

Imagine That Inc., San Jose, CA, has introduced Extend™ for Windows and Macintosh version 3.1, **dynamic modeling and simulation software** for modeling and analyzing systems, processes, and components. Users can simulate and validate ideas by experimenting on an existing model before implementing changes. Prices for both platforms start at \$695.

For More Information Write In No. 733

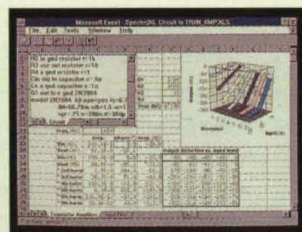
Autodesk® View Windows-based **file viewing software** from Autodesk Inc., San Rafael, CA, provides the ability to review and work with AutoCAD® files, raster files, and nongraphic business application files without having AutoCAD or other application software. It permits mark-up, plotting, and printing of AutoCAD drawings and scanned images. The cost is \$295.

For More Information Write In No. 734



Visual Numerics Inc., Boulder, CO, has released version 6.0 of PV-WAVE **visual data analysis software**. Enhancements include an extended programming language with new data types and manipulation features, cross-platform compatibility, and a new options programming interface. A floating UNIX license starts at \$4495; the Windows version is \$1995.

For More Information Write In No. 735



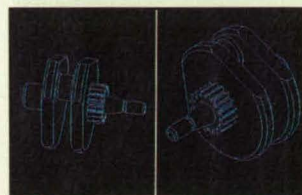
Spectre/XL **analog design spreadsheet software** from Avista Design Systems, Folsom, CA, embeds circuit simulation inside Microsoft Excel, allowing analog designers to evaluate, develop, and optimize circuit designs. Using several spreadsheets, designers can encapsulate entire system designs in a single Excel-based workbook. The software costs \$695.

For More Information Write In No. 736



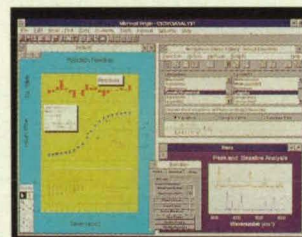
Optimas Corp., Bothell, WA, has introduced Optimas Library, a multi-user **technical image database** that tracks large numbers of images for data management and batch image analysis. The software uses a drag-and-drop design module to modify existing databases or create custom databases. It provides network support and DDE links with other Windows applications, including OPTIMAS image analysis software.

For More Information Write In No. 737



MechShaft **parametric shaft designer and symbol library software** from EMT Software, Bellingham, WA, creates designs in AutoCAD with user-specified parameters. Once a shaft is created, design changes can be made inside AutoCAD through a dialog box. The symbol library includes holes, threads, grooves, gears, bearings, and pulleys. Cost: \$295.

For More Information Write In No. 738

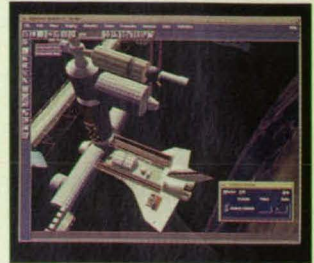


Microcal Software Inc., Northampton, MA, has introduced Origin version 4.0 **graphics and data analysis software** for Windows. New features include enhanced digital signal processing, a nonlinear curve fitter, publication-quality graphics, and add-on modules. Prices are \$495 for the basic program; \$545 with an optional 3D and contour module.

For More Information Write In No. 739

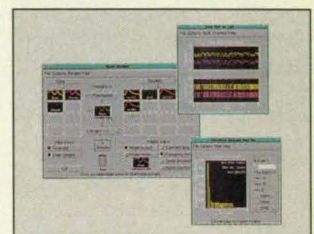
Visualization Data Explorer™ 3.1 **data visualization and analysis software** from IBM, Yorktown Heights, NY, manipulates, transforms, animates, and renders data generated by models, simulations, observations, and experiments. Users can visualize information and detect correlations in data. License prices start at \$5900.

For More Information Write In No. 740



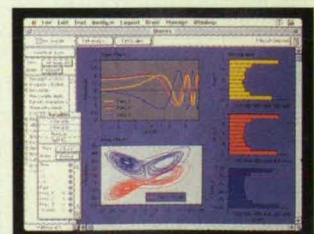
Coryphaeus Software Inc., Los Gatos, CA, has announced Expression™, an OpenGL™ **3D graphics software suite** for real-time, interactive generation of 3D graphics. Users can create, prototype, and test 3D virtual environments for simulation-based training and design/engineering applications. The program supports head-mounted displays and tracking devices, and reads more than 30 common file formats. The base price is \$14,999; a 3D modeler module is \$9999 and a programmer's module is \$4999.

For More Information Write In No. 741



The MathWorks Inc., Natick, MA, has introduced two **modeling and simulation software** tools that integrate with MATLAB® and SIMULINK® development environments. Fixed-Point Blockset 1.0 is used with SIMULINK to model and simulate effects of fixed-point processors used to develop control devices. System Identification Toolbox 4.0 performs stability analysis of existing systems, generating linear models used in control system design. Each program costs \$595 in either PC or Mac versions.

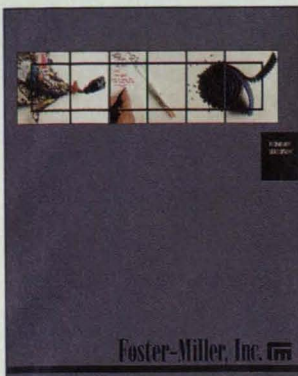
For More Information Write In No. 742



Abacus Concepts, Berkeley, CA, has released StatView® version 4.5 **statistical analysis software** for Macintosh that includes survival analysis, quality control, enhanced statistical analysis, and more than 20 new analysis/graphing templates. With Excel read/write capabilities, Excel files can be imported directly into the program. The cost is \$595.

For More Information Write In No. 743

New Literature



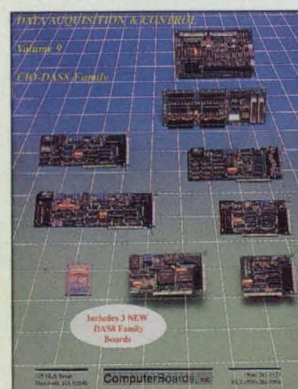
Foster-Miller Inc., Waltham, MA, offers a brochure describing **product and machinery development** services, including conception and development of products, transforming prototypes to working equipment, and developing manufacturing systems.

For More Information Write In No. 720



A 24-page "Design Solutions" brochure on **powder metallurgy** from the Metal Powder Industries Federation, Princeton, NJ, describes how PM parts are made, how to choose materials, engineering properties, and the design, applications, specifications, and benefits of PM parts.

For More Information Write In No. 721



Computer Boards, Mansfield, MA, has released Volume 9 of its **data acquisition hardware and software** catalog. More than 50 products are featured, including the new CIO-DAS8 family of A/D cards, and LabTech Notebook software.

For More Information Write In No. 722

LeCroy Corp., Chestnut Ridge, NY, offers the 1996 edition of its **test and measurement** product catalog, featuring oscilloscopes, probes, related software, and accessories. Technical tutorials and applications are included.

For More Information Write In No. 723

A CD-ROM **electronic parts** catalog from Eaton Corp. Engineered Fasteners Division, Cleveland, OH, features schematics, images, application information, and technical data on more than 5000 fasteners. It is available in Windows and Mac formats.

For More Information Write In No. 724



A 16-page catalog of **motion control equipment** is available from Industrial Indexing Systems, Victor, NY. Included are servo motion control systems, motor drive packages, and related software.

For More Information Write In No. 726

Techno-Sommer - Automatic, New Hyde Park, NY, has released a 284-page catalog of **automation components**, including tool changers, linear actuators, rotary actuators, and 112 models of pneumatic grippers.

For More Information Write In No. 725



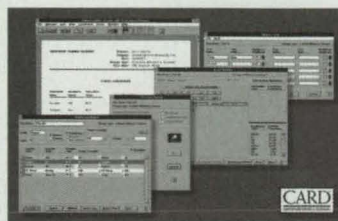
SUNX, West Des Moines, IA, has introduced a 36-page **sensors** catalog that features photoelectric, fiber-optic, proximity, image, laser beam, ultrasonic, and ultraviolet sensors. Included are technical specifications and diagrams.

For More Information Write In No. 727

CARD! THE Windows™ Software for Design Of Experiments

CARD, (Computer Aided Research and Development), has the **power and flexibility to meet ALL of your DOE needs.**

Create classical designs and state-of-the-art algorithm designs. Meet requirements of regulatory agencies with statistically correct, independently defensible databases. Identify information



Perfect DOE in four easy stages

CARD is the Windows software designed **specifically** for DOE.

Order CARD now for \$495 (plus s & h) and receive **Designed Experiments and Information**, an excellent DOE introductory text **FREE** with return of your registration card.

ORDER NOW! CALL: 1-800-325-1862

FAX: (415) 945-3877, e-mail: westing3@aol.com

Westing Software, Inc., 134 Redwood Ave., Corte Madera, CA 94925

For More Information Write In No. 438

ELECTROMAGNETICS



New MagNet 5.1:

- ▷ PC support for Windows
- ▷ Adaption in 2D and 3D
- ▷ 3D transient solutions
- ▷ 3D eddy current solutions
- ▷ Variable element orders
- ▷ 2D/3D modular upgrades
- ▷ Open architecture
- ▷ Professional support



- ▷ 3D high frequency solutions
- ▷ electromagnetics solution
- ▷ scattering parameters
- ▷ includes lossy dielectrics

PHASAR

- ▷ phased-array antennas
- ▷ systematic errors
- ▷ random errors
- ▷ changes in beam pattern

Infolytica

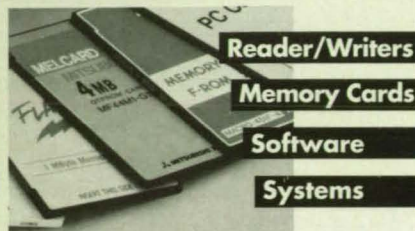


Call 514-849-8752 today for free demo disk and booklet.

For More Information Write In No. 439

PCMCIA

PC Memory Cards from Adtron



Solving Your PCMCIA System Needs

3050 S. Country Club Dr. • Suite 24 • Mesa, AZ 85210
602-926-9324 • FAX 602-926-9359

For More Information Write In No. 580

Free Drive Component Library!
Featuring over 50,000 Off-The-Shelf Inch & Metric, Commercial & Precision Small Drive Components



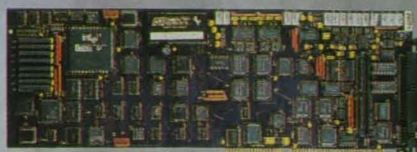
Fax: 516-326-8827 or Call: 516-328-3300



2101 Jericho Turnpike, Box 5416
New Hyde Park, NY 11042-5416

For More Information Write In No. 581

Intelligent Data Acquisition



■ The 486-based DAP 3200e™ Data Acquisition Processor™ board has its own on-board multitasking real-time operating system, DAPL™, that does the time-critical work in an application. DAPL, optimized for data acquisition and control, recognizes 100+ standard commands. A typical application is completely defined with DAPwindows™ in just minutes.

■ DAPwindows, running on the PC under Windows, can issue commands to DAPL to acquire data or control processes in real time through the Data Acquisition Processor, freeing an application from unacceptable delays imposed by Windows. Special on-board hardware bypasses DMA to drive the bus at maximum speed.

Please contact us to discuss your project, or for information:
206-453-2345
206-453-3199 FAX

2265 116th Avenue NE
Bellevue, WA 98004

**MICROSTAR
LABORATORIES**

For More Information Write In No. 582



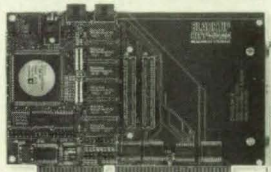
FREE!
130
Page
Catalog

"Optics
for
Industry"

Free 130 page product catalog from Rolyn, world's largest supplier of "Off-the-Shelf" optics. 24-hour delivery of simple or compound lenses, filters, prisms, mirrors, beamsplitters, reticles, objectives, eyepieces plus thousands of other stock items. Rolyn also supplies custom products and coatings in prototype or production quantities. **ROLYN OPTICS Co.**, 706 Arrowgrand Circle, Covina, CA 91722-2199, (818)915- 5707, FAX (818)915-1379

For More Information Write In No. 583

**100 MFLOP
OEM-DSP
\$889 QTY 100**



BLACKTIP

- Analog Devices ADSP-2106x SHARC floating-point DSP
- Up to 512K x 48 external SRAM
- Flexible high-speed I/O site
- Two external link ports
- Half-length ISA card
- Free evaluation packages from Hyperception, Ixthos, and Wideband Computers with purchase of development SW

BITTWARE RESEARCH SYSTEMS

The SHARC tuners.

800-848-0436

33 North Main Street • Concord, NH 03301
FAX: 603-226-6667 • E-Mail: bittware@bittware.com

For More Information Write In No. 584

**8X ZOOM! HI-RES COLOR!
RS-232 CONTROLLABLE
THE BEST OF ALL WORLDS
IN SMALL VIDEO CAMERAS**

Call **SEKAI** at
1-800-921-7776



For More Information Write In No. 585



Now get C-programmable miniature controllers with non-volatile "flash" memory. Our **Dynamic C™** development system makes it easy—only \$195. Call our AutoFAX today! Dial 916.753.0618 from your FAX and request catalog #18.



1724 Picasso Ave.
Davis, CA 95616
916.757.3737
916.753.5141 FAX

For More Information Write In No. 586

You Can Turn Your PC Into A Waveform Recorder!

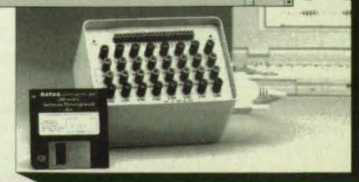
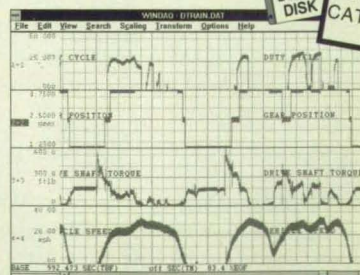
Today's most advanced data recording systems are not paper chart recorders. They're paperless, PC-based data acquisition systems from Dataq Instruments. We've replaced traditional instruments in a variety of applications with low-cost and flexible alternatives that save our customers thousands in paper costs alone. Factor in the productivity gains of computer-based analysis, and you have a solution you can't afford to ignore.

- ◆ Battery-powered and desktop solutions
- ◆ Hard copy to any graphics printer
- ◆ Sample rates of 1 to 500,000 Hz
- ◆ Connects from 1 to 240 channels to any PC

DATAQ INSTRUMENTS, INC.
800-553-9006

For More Information Write In No. 587

CALL FOR
**FREE
INFORMATION**



ADVERTISERS INDEX



RUGGED, HIGH PERFORMANCE SYSTEM WITH COLOR VGA DISPLAY & ATTACHED KEYBOARD

ST-3500P STANDARD FEATURES INCLUDE:

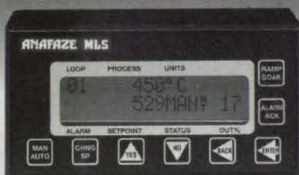
- 14 SLOT PASSIVE BACK PLANE, ISA/EISA/PCI
- 300WATT 110/220V AC 50-400HZ POWER SUPPLY
- 80486DX2/DX4 OR PENTIUM 90/100/133 CPU CARD
- 10.4" TFT COLOR DISPLAY, 640X480X64K COLORS
- SHOCK ISOLATED DRIVE CAGE TO MOUNT ONE 3.5" AND TWO 5.25" HALF HEIGHT DRIVES
- KEYBOARD AND TRACK BALL MOUSE
- SERIAL AND PARALLEL PORTS, MS DOS/WINDOWS

OPTIONS: TOUCH SCREEN, CUSTOM CONFIGURATIONS,
FOR FURTHER DETAILS CONTACT:

IBI SYSTEMS INC., 6842 NW 20 AVE
FT. LAUDERDALE, FL 33309
305-978-9225 FAX: 305-978-9226

For More Information Write In No. 588

PID MULTI-LOOP CONTROLLERS—



AND A LOT MORE!

Multi-loop PID Controllers are quickly and easily integrated into your machine or process control system. From 4 to 512 loops in a single, space-saving package. Multiple inputs accept nearly any type or mix of sensors. One controller measures and controls all loops in the process, not just one input type or loop. Use standalone or with a PC running our high-level ANASOFT software.

Call, write, or fax for complete information...

WATLOW ANAFAZE

334 Westridge Drive, Watsonville, CA 95076
Phone: (408) 724-3800 Fax: (408) 724-0320

For More Information Write In No. 589



Official NASA Tech Briefs Cap

Sporty poplin cap perfect for golf or any outdoor activity. Red and black NASA Tech Briefs logo on white cap. Size adjustable. \$9.95

Name _____
Address _____
City _____
State _____ Zip _____

Mail with payment to: Associated Business Publications
317 Madison Avenue, Ste 921, New York, NY 10017.
For credit card orders call (212) 490-3999

ACL Incorporated	(RAC 449)	66	Lumitex, Inc.	(RAC 432)	95
Adaptive Research	(RAC 524)	37	MacNeal-Schwendler Corporation	(RAC 561)	23
Adtron	(RAC 580)	104	Macro Engineering	(RAC 435)	100
Algor, Inc.	(RAC 525,328)	9,69	Magne Corporation	(RAC 334)	18a
Amco	(RAC 404)	56	Magsoft Corporation	(RAC 442)	90
AMP	(RAC 549)	24-25	Massachusetts Institute of Technology	(RAC 428)	88
Andeen-Hagerling, Inc.	(RAC 466)	17a	Master Bond Inc.	(RAC 440)	106
Ansys, Inc.	(RAC 601)	55	Mathsoft	(RAC 416)	72
APD	(RAC 329,330)	69	MathWorks, Inc.	(RAC 571)	43
Arconium	(RAC 403)	34	Microstar Laboratories	(RAC 582)	104
Astro-Med, Inc.	(RAC 531,314)	39,68	Minco Products, Inc.	(RAC 433)	95
Ball Screws & Actuators Co. Inc.	(RAC 320)	68	National Electrostatics Corp.	(RAC 326)	69
Belt Technologies	(RAC 415)	71	National Instruments Corporation (RAC 503,450)	COV II, COV IIa	
Bitware Research Systems	(RAC 584)	104	National Technology Transfer Center	(RAC 406)	46
Cincinnati Electronics Corporation	(RAC 317)	68	Northern Research Systems	(RAC 410)	60
Cole-Parmer Instrument Company	(RAC 528,315)	13,68	Novamet Specialty Products Corporation	(RAC 519)	49
Concepts ETI, Inc.	(RAC 414)	50	Numerica Software Corporation	(RAC 660)	2
Cybernetics	(RAC 529,603)	7,41	Numerical Algorithms Group Inc.	(RAC 431)	93
Data Electronics USA, Inc.	(RAC 465)	15a	Omega Engineering, Inc. (RAC 615,616,300-308)	1,67	
Data Translation	(RAC 530)	15	Parts Express	(RAC 311)	68
Dataq Instruments, Inc.	(RAC 587)	104	PC Video Conversion	(RAC 419)	76
Deltrol Controls	(RAC 331)	69	Penn Engineering & Manufacturing Corp.	(RAC 417)	74
Derwent North America (RAC 413,327,425)	62,69,83		PIC Design	(RAC 318)	68
De-Sta-Co	(RAC 322)	69	Plan Hold International	(RAC 333)	69
Digi-Key Corporation	(RAC 532)	5	Pragmatic Instruments Inc.	(RAC 460,461)	7a
Document Engineering Co., Inc.	(RAC 446,447)	99	Racal Recorders, Inc.	(RAC 482)	COV IVa
DuPont Corporation	(RAC 573)	10-11	RAG Electronics	(RAC 508)	3
Eastman Kodak Company	(RAC 424)	84	Remec Humphrey	(RAC 429)	91
Elgiloy Limited Partnership	(RAC 316)	68	Research Systems, Inc.	(RAC 555)	17
Elmo Mfg. Co.	(RAC 462)	1a	RGB Spectrum	(RAC 400)	12
Elmwood Sensors	(RAC 418)	76	Rolyn Optics Co.	(RAC 313,583)	68,104
Engineering Sciences Data Unit (ESDU)	(RAC 325)	69	Science Accessories	(RAC 407)	52
Enterprise Software Products, Inc.	(RAC 421)	79	Sekai	(RAC 585)	104
Envoy Data Corporation	(RAC 324)	69	Servometer Corporation	(RAC 323)	69
EPIX, Incorporated	(RAC 423)	82	Softworld	(RAC 426)	78
Evans	(RAC 402)	19	Sony Magnescale America, Inc.	(RAC 451)	3a
Ferro Corporation	(RAC 443)	96	Sorbothane Inc.	(RAC 332,437)	69,101
Festo Corporation	(RAC 310)	68	Specialized Products Co.	(RAC 335)	18a
Flir Systems	(RAC 501)	85	Sterling Instruments	(RAC 581)	104
Gage Applied Sciences Inc.	(RAC 509)	4	Stevens Products, Inc.	(RAC 321)	68
Gould Instrument Systems Inc.	(RAC 539)	COV VI	Sun Microsystems Inc.	(RAC 567)	29
Hardigg Cases	(RAC 319)	68	SUNX Sensors	(RAC 570)	75
Heidenhain Corporation	(RAC 463)	9a	The Swagelok Companies	(RAC 541)	73
Hewlett-Packard Company	(RAC 670)	33	Synrad	(RAC 538)	27
IBI Systems	(RAC 588)	105	Teledyne Relays	(RAC 401)	16
Infolytica Corporation	(RAC 439)	103	Thompson Casting Co., Inc.	(RAC 434)	100
Inframetrics, Inc.	(RAC 520)	77	Velmex, Inc.	(RAC 436)	101
Intergraph Corporation (RAC 408,409,411,412)	57, 59, 61, 63		Visual Numerics	(RAC 611,612)	65, COV III
IOtech, Inc.	(RAC 590-595)	53	Visual Solutions	(RAC 312)	68
Janco	(RAC 444)	87	Watlow/Anaface	(RAC 589)	105
Jandel Scientific Software	(RAC 625-633)	47	Watlow Electric Mfg. Company	(RAC 505)	35
Keithley	(RAC 572)	45	Westing Software	(RAC 438)	103
Kinetic Systems Corporation	(RAC 420)	80	Xitron Technologies Incorporated	(RAC 452-455)	5a
Krohn-Hite Corp.	(RAC 464)	12a	Z World Engineering	(RAC 586)	104
Lambda Advanced Analog Inc.	(RAC 551)	31			
Light Machines Corporation	(RAC 422)	79			

*RAC stands for Reader Action Card. For further information on these advertisers, please write in the RAC number on the Reader Action Card in this issue. This index is compiled as a service to our readers and advertisers. Every precaution is taken to insure its accuracy, but the publisher assumes no liability for errors or omissions.

BOND DISSIMILAR SUBSTRATES

-420°F to +250°F

SUPREME 11F EPOXY SYSTEM

- 5-min. fixture at room temperature
- Easy to apply, 1/1 mix ratio
- Strong bonding to metals, plastics, ceramics, glass & wood
- Resists water, fuels, lubricants & aggressive chemicals
- Superior electrical insulation
- High dimensional stability & durability
- Outstanding toughness & impact strength
- Job-tailored packaging



For information, call or write:
Master Bond Inc.
154 Hobart St.
Hackensack, NJ 07601
201-343-8983

Master Bond Inc.
Adhesives, Sealants & Coatings

For More Information Write In No. 440

The Technology Connection

To Advertise Call (800) 944-NASA

Connecting with Consultants

East

Robert P. Bell
Robert Platt Bell, P.C.
P.O. Box 19668
Alexandria, VA 22320
(703) 683-8822

Attorneys specializing in patent application preparation and prosecution, copyright, and trademark matters.

Fisher & Associates
1700 Diagonal Road, Suite 200
Alexandria, VA 22314
(703) 739-4805
Fax: (703) 739-4809

Patent, trademark, copyright, and licensing matters.

Engineering Catalog

80/20 Inc. FAST

Manufacturers of The Industrial Erector Set®
T-SLOT ALUM. EXTRUSIONS
for Machine Frames, Work Stations, Shop Projects, Guarding, Enclosures, Etc.
FREE "Book of Solutions" catalog with over 1400 stock components
(219) 478-8020 • FAX 478-8121
2570 Commercial Road • Fort Wayne, IN 46809

Meetings

Mark your calendar now for

**TECHNOLOGY
2006**

October 29-31,
1996

Anaheim
Convention Center
Anaheim, CA

Technology for Transfer

YOU missed Technology 2005? TRANSCIENCE ASSOCIATES INC. demonstrated a NEW concept: Rubber-Gear Gear Pumps as SUPERB computer peripherals. U.S. PATENT #5,163,824 is now FOR SALE by Inventor/Owner. H.H. Kantner, 1112 Hinman Ave., Evanston, Illinois 60202-1311.

Inventors

If you have an invention for sale or license, call for free booklet explaining how we can help you. 1-800-537-1133, Kessler Sales Corporation, C-67-5, Fremont, Ohio 43420.

Apollo 11 Commemorative T-Shirt

Striking full-color illustration on quality white T-shirt recaptures the spirit and excitement of the Apollo moon landing. Available in children's and adult sizes - S, M, L \$12.95 each plus \$5.00 shipping/handling. (NY residents add sales tax.)



Mail order with check to: Associated Business Publications, Dept. F, 317 Madison Avenue, Suite 921, New York, NY 10017. Be sure to indicate size(s). Credit card orders call (212) 490-3999.

NASA Tech Briefs, ISSN 0145-319X, USPS 750-070, copyright© 1995 in U.S., is published monthly by Associated Business Publications Co., Ltd., 317 Madison Ave., New York, NY 10017-5391. The copyrighted information does not include the U.S. rights to individual tech briefs which are supplied by NASA. Editorial, sales, production and circulation offices at 317 Madison Ave., New York, NY 10017-5391. Subscription for non-qualified subscribers in the U.S., Panama Canal Zone, and Puerto Rico, \$75.00 for 1 year \$125.00 for 2 years; \$200.00 for 3 years. Single copies \$10.00. Foreign subscriptions one-year U.S. Funds \$195.00. Remit by check, draft, postal, express orders or VISA, MasterCard, or American Express. Other remittances at sender's risk. Address all communications for subscriptions or circulation to NASA Tech Briefs, 317 Madison Ave., New York, NY 10017-5391. Second Class postage paid at New York, NY and additional mailing offices.
POSTMASTER: please send changes to NASA Tech Briefs, P. O. Box 10523, Riverton, NJ 08076-0523.

Now You Can Renew

(Or Apply For)

A NASA Tech Briefs
Subscription On-Line Through
The NTB Home Page:

<http://www.keds.com/ntb>

You must requalify once a year to receive NASA Tech Briefs. Please check the four-digit qualification date at the upper right of your address label. If more than six months have passed, now is the time to renew your subscription.

Move to the Plus Side of Math –



NEW!

IMSL® Math Module for C++ . . .

*positively the easiest way
to develop technical applications!*

Get your math from the math experts.

Now the object-oriented development tools you need are available as class libraries from the name you have relied on for nearly 25 years for numerical analysis and technical application development. The IMSL Math Module for C++ is the first release from Visual Numerics' new family of object-oriented development tools, Visual Numerics' *ObjectSuite™*.

The **IMSL Math Module for C++** is a unique cross-platform, object-oriented C++ class library that speeds your application development by giving you advanced mathematical and basic statistical components that are robust, reusable, and save you time on code development and maintenance.

- Includes classes in a variety of precisions for complex arithmetic, vectors, matrices, matrix decomposition, interpolation and approximation, pseudorandom number generation.
- Conforms to established conventions of C++ programming.
- Built upon efficient algorithms.
- Includes comprehensive online documentation.

Coming Soon!

Two new members to the *ObjectSuite* family!

IMSL Business Charting Module for C++

An object-oriented class library of business graphs such as bar charts, pie charts, scatter plots, and 3D surface and contour plots.

IMSL Signal Processing Module for C++

A class library of reusable components to solve signal processing problems involving complex numbers, vector and matrix computations, signals and systems, filter approximation, filter realization and much more!

Supported systems:

- Intel-based PCs running Windows® with Win32s™ or Windows NT™
- Sun Microsystems and Hewlett-Packard workstations
- Coming soon for Windows® 95

IMSL Fortran and C/C++
Application Development Tools

Visual Numerics and IMSL are registered in the U.S. Patent and Trademark Office by, and *ObjectSuite* is a trademark of, Visual Numerics, Inc. Windows, Windows NT and Windows 95 are trademarks or registered trademarks of Microsoft Corporation. All other product and company names are trademarks or registered trademarks of their respective companies.



When you build your applications with the IMSL Math Module for C++ you will:

- dramatically decrease your development time.
- save thousands of dollars in design, testing and maintenance.
- get comprehensive online documentation.
- save – no run time fees.
- develop object-oriented cross-platform solutions.

"I prefer the way Visual Numerics' IMSL Math Module for C++ works over other commercially available C++ class libraries. It has an easier installation, richer functionality, better performance and outstanding documentation."

– Jakob Kamm
Senior Systems Designer
Consultant for Swiss Bank Corporation
Switzerland

Get your math from the math experts. Call today!

1-800-364-8880

Visual Numerics®

phone (713) 954-6785 fax (713) 781-9260

e-mail: marketing@houston.vni.com

<http://www.vni.com>

London +44 (0) 1753-790600 • Paris +33-1-46-93-94-20

Stuttgart +49-711-13287-0 • Taiwan 886 (0) 2-727-2255 • Tokyo +81-3-5689-7550

For More Information Write In No. 612

AD95137

Mix multiple instruments into your data acquisition brew and you might conjure up something you wouldn't want to live with!

Used to be, you had to conjure up a variety of test instruments to overcome the inherent limitations of single function products. The result was a monster of different instruments, data formats, cables and user interfaces that increased the headaches, time and cost of design testing.

Now, there's a better way. With the ACQuLab™ Data Acquisition System from Gould Instrument Systems, all critical test functionality is combined in a single system, controlled by a single graphic user interface for enhanced data acquisition, new perspectives and real-time answers to challenging test applications.

Only ACQuLab provides functionality in all five critical areas of data acquisition: input signal conditioning, continuous data acquisition, real-time monitoring, real-time hard copy, and data playback and analysis. With ACQuLab, all

these capabilities are fully integrated and easily transported to remote test locations. And, since ACQuLab converts raw data to useful information at the time and place of acquisition, you make the most effective use of valuable test cell resources.

ACQuLab takes the monster off your benchtop and replaces it with a comprehensive, efficient, real-time data acquisition system.

See how the ACQuLab Data Acquisition System will solve your testing problems. **Call (800) 468-5365 today.**



GOULD
Instrument Systems

Gould Instrument Systems, Inc.
8333 Rockside Road
Valley View, Ohio 44125

ACQuLab is a trademark of Gould Instrument Systems, Inc.
©1995 Gould Instrument Systems, Inc.

For More Information Write In No. 539